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ESTERLINE ANGUS SERIES S

INSTRUCTIONS

for the use of Esterline Angus
graphic recording instrument
SERIAL NUMBER 802060

INSTRUCTION MANUAL

FOR

SERIES "S" RECORDERS

ESTERLINE ANGUS

Excellence in instrumentation for over 60 years

SERIAL NUMBER

TPS - 2

CONTENTS

SECTION A — INSTALLATION

UNPACKING
INSTALLATION PROCEDURES
DISASSEMBLY
CASE REPLACEMENT PARTS

SECTION B — OPERATION

CONNECTIONS
OPERATING PROCEDURES
ADJUSTMENTS
MAINTENANCE

SECTION C — CHART DRIVE

PRINCIPLE OF OPERATION
SPECIFICATIONS
CHARTING PROCEDURES
ADJUSTMENTS
MAINTENANCE

SECTION D — SPECIFICATIONS

MEASURING ELEMENT DESCRIPTION
TECHNICAL SPECIFICATIONS

APPENDIX —

OPTIONAL FEATURES
CUSTOM MODIFICATIONS

ESTERLINE ANGUS

INSTRUMENT DATA SHEET—CUSTOMIZED SPECIFICATIONS

HIGH IMPEDANCE ADAPTER

SERIES "S", MODEL S-620- T EVENT RECORDER WITH TEMPREV + CHANNELS TWENTY

Sold to GENERAL TELEPHONE CO. OF INDIANA, FORT WAYNE, INDIANA

Pur. Order No. 23-3013-68 S.O. No M7102A Date 5/29/68

For use by SAME

CASE LABGRAPH Color Lamp

Other Case Features

STYLUS HEATING CIRCUIT: Model B-17301 Rating 120V-60CPS

Scale 1 THRU 20 CHANNELS Sc. No. 45263-2 CHART No. 37020-X

ELECTROMAGNET ASSEMBLIES 20-TPT N.P. No. 45305, 41027, 45234

Type: VOLTAGE TYPE - SEPARATE CIRCUITS

Mag. Numbers 1 THRU 20 Rating 48 V- D.C. Av. Coil Resistance Series Res.

Mag. Numbers Rating Av. Coil Resistance Series Res.

Mag. Numbers Rating Av. Coil Resistance Series Res.

Mag. Numbers Rating Av. Coil Resistance Series Res.

INPUT TO THERMAL ELEMENT 120 VOLTS-60 HZ.

E Mult. Box SEP. PART No. LE-6173 Volts VOLTAGE SENSING MODULE Mult. N.P. No. 7312

Mult. Box No. Volts Mult. N.P. No.

TERMINAL CODE PLATE (CONNECTIONS)

TERM.	RATING	CHANNEL	RATING
1 POWER INPUT - NEUTRAL	- 120V-60CPS	1 THRU 20	48 V- DC
2 POWER INPUT - LINE	- 120V-60CPS		
S-9466			

SEE TERMINAL CODE PLATE ON RECORDER FOR ELECTROMAGNET CONNECTIONS

I.D. No. 45334-2 CONNECTION DIAGRAMS 43094 ON REAR OF CASE, 45334-2

SPECIAL FEATURES: INPUT VOLTAGE 12 TO 55 VOLTS-DC IN MODE NO. 1 OR MODE NO. 2 POSITION. POWER SOURCE 120V-60HZ. SEE S-9517 FOR WIRING OF LE-6173 TO RECORDER.

E FURNISH ONE 3' CONNECTING CABLE WITH PLUGS PER DWG. NO. S-20447.

CHART DRIVE: CATALOG No. 227 - HOUR - MINUTE - SECOND - SPEEDS

Feeds: In. per Hr. 3/4-1 1/2-3-6-12 In. per Min. 3/4-1 1/2-3-6-12 In. per Sec. 3/4-1 1/2-3-6

Chart Transp. No. 45120 Transmission No. 41200-16 Motor Mod. 40475-2 Volts 120 CPS 60

Trip Coil: No. Volts C.P.S. Ohms Series Ohms

Sec. Feed Motor: No. 40497 Part No. 40498 Volts 120 C.P.S. 60

E Other Chart Drive Features: FURNISH ONE No. 45268 POWER LEAD.

DIELECTRIC TESTS—(Terminals to case): Coil Circuits 1500 Thermal Circuit 600

Input Circuits Power Supply Hr./Min. Feed Motor 600

Sec. Feed Motor 600 Lamp Cir. Trip Coil

AUXILIARY APPARATUS

Control Trans. Mfr. Model Volts: Pri. Sec. C.P.S.

Elec. Counter Mfr. Model Mtg. Volts C.P.S.

Switches Mfr. Model Mtg.

NOTE: MODIFY BACK PLATE & COVER PLATE PER S-20449 & S-20450

D.S. by I.D.T. Master Card Entry Card. by

Inspections: 45334-2 Final Date

SERIAL No. 802060

Mention this number in correspondence

SECTION A

GENERAL INSTRUCTIONS FOR SERIES "S" LABGRAPH* RECORDERS

THE ESTERLINE ANGUS LABGRAPH RECORDER IS A BENCH-TOP MODEL SPECIFICALLY DESIGNED FOR PORTABLE APPLICATIONS. A WIDE VARIETY OF MEASURING ELEMENTS AND SYNCHRONOUS CHART DRIVES ARE AVAILABLE IN THIS GRAPHIC INSTRUMENTATION LINE. FOR A COMPLETE DESCRIPTION OF THE PARTICULAR TYPE OF RECORDER ORDERED, REFER TO THE DATA SHEET ACCOMPANYING THIS INSTRUCTION MANUAL.

UNPACKING

A PACKING SLIP LISTING ALL ENCLOSED ITEMS IS INCLUDED WITH EACH SHIPMENT. CHECK OFF THE ITEMS AS THEY ARE UNPACKED; IF ANYTHING IS MISSING, GO THROUGH THE PACKING MATERIAL CAREFULLY BEFORE THROWING IT AWAY. AFTER REMOVING THE INSTRUMENT FROM ITS PACKING CASE, INSPECT THE UNIT FOR PHYSICAL DAMAGE. SEE THAT THE CHART TRANSPORT LATCHES SECURELY IN POSITION, AND THAT ALL PANEL CONTROL KNOBS TURN FREELY. IF THE SHIPMENT HAS BEEN DAMAGED IN TRANSIT, NOTIFY BOTH THE CARRIER AND ESTERLINE ANGUS COMPANY AT ONCE. REMOVE PACKING MATERIALS FROM THE INSTRUMENT CASE AND UNPACK ALL ACCESSORY ITEMS.

CAUTION: DO NOT ATTEMPT TO OPERATE A DAMAGED INSTRUMENT.

GENERAL DESCRIPTION

ALL LABGRAPH RECORDERS ARE HOUSED IN A PORTABLE METAL CASE WITH LARGE CARRYING HANDLE FOR A CONVENIENT "CENTER-OF-BALANCE" GRIP. A HINGED LID IS PROVIDED AT THE TOP-FRONT OF THE CASE FOR QUICK ACCESS TO THE CHART-TRANSPORT RELEASE LEVER AND WRITING ELEMENTS. THE FRONT PANEL INCLUDES AN "ON" INDICATOR LAMP, SCALEPLATE, AND CHART-DRIVE CONTROLS.

A PORTION OF THE CHART TRANSPORT PROTRUDES FROM THE FRONT OF THE CASE, THUS OFFERING THE OPERATOR A CONVENIENT WRITING TABLE FOR MAKING NOTATIONS ON THE RECORDED CHART. THE SMALL PANEL JUST TO THE LEFT OF THE WRITING TABLE WILL USUALLY CONTAIN UNIVERSAL-TYPE BINDING POSTS FOR SIGNAL INPUTS ---- PLUS CONTROLS OR SWITCHES THAT MAY REQUIRE FREQUENT ADJUSTMENT.

A SEPARATE POWER CORD AND WALL-PLUG ADAPTER IS SUPPLIED WITH EACH LABGRAPH RECORDER. THE SOCKET OF THIS CORD ATTACHES TO AN INTER-LOCK TYPE PLUG ON THE REAR OF THE CASE. DIRECTLY ABOVE THE POWER CONNECTOR IS A LINE FUSE WHICH PROTECTS ALL AC-POWERED COMPONENTS WITHIN THE INSTRUMENT.

REMOVING THE BACKPLATE ON THE REAR OF THE CASE EXPOSES THE TERMINAL CONNECTIONS THAT MAY BE PROVIDED FOR VARIOUS FUNCTIONS OF THE INSTRUMENT. A TERMINAL CODE PLATE LISTING ALL CONNECTIONS AND RATINGS IS FOUND ON THE INSIDE SURFACE OF THE BACKPLATE. ALWAYS REFER TO THIS PLATE BEFORE MAKING ANY ELECTRICAL CONNECTIONS.

THE RECORDER CHASSIS FOR A LABGRAPH INSTRUMENT INCORPORATES THREE MAJOR SECTIONS: THE CHART TRANSPORT ASSEMBLY, WHICH IS FOUND AT THE FRONT OF THE CHASSIS; THE GRAPHIC MEASURING ELEMENT, CENTERALLY POSITIONED; AND THE CHART-DRIVING MECHANISM, LOCATED NEAR THE REAR. EACH SECTION HAS BEEN CAREFULLY DESIGNED WITH MODULAR COMPONENTS TO FACILITATE SERVICING AND PARTS REPLACEMENT.

DO NOT RESTRICT AIR CIRCULATION IN AND AROUND THE RECORDER. AMBIENT OPERATING TEMPERATURES MUST NOT EXCEED 120°F. IN ADDITION, THE INSTRUMENT SHOULD NOT BE POSITIONED CLOSE TO TRANSFORMERS OR CONDUCTORS CARRYING HIGH CURRENTS.

> WARNING: IF AN EARTH-GROUND POWER SOURCE IS NOT AVAILABLE, IT IS RECOMMENDED THAT A SEPARATE GROUND CONNECTION BE MADE TO THE RECORDER CASE.

DISASSEMBLY

ACCESS TO CHASSIS COMPONENTS IS MADE POSSIBLE BY A DETACHABLE TOP SECTION OF THE LABGRAPH CASE. BEFORE REMOVING THIS SECTION, HOWEVER, ALWAYS SEE THAT THE POWER CORD IS DISCONNECTED AND THAT OTHER HIGH POTENTIALS ARE REMOVED FROM INPUT TERMINALS.

THE TOP SECTION OF THE CASE MAY BE TAKEN OFF BY REMOVING 3 SCREWS FROM EACH SIDE OF THE LOWER BASEPLATE. LIFT THE SECTION FROM THE CHASSIS AS PICTURED IN FIG. A1.

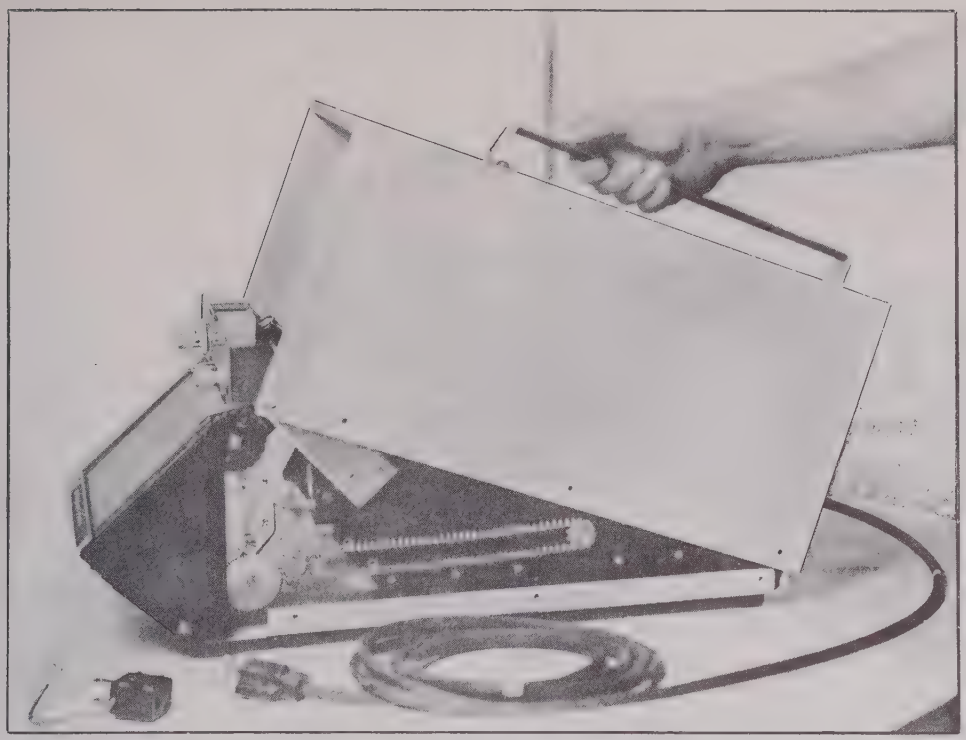


FIG. A1. WITH TOP OF LABGRAPH CASE REMOVED, ALL MODULAR CHASSIS COMPONENTS ARE ACCESSIBLE FOR INSPECTION OR SERVICING.

FIELD REPLACEMENT PARTS

CASE ASSEMBLY

E-A PART NO.	NOMENCLATURE
45068	CORD, POWER (WITH SOCKET AND PLUG)
8935-J	ADAPTER, POWER PLUG (WITH GROUND WIRE)
14359	FUSE, 3AG SLO-BLO (2A, 250V)
14386	HOLDER, FUSE
43034	GROMMET, REAR PANEL (LARGE)
43101	PLUG BUTTON, REAR PANEL (LARGE)
20190	GROMMET, REAR PANEL (SMALL)
43100	PLUG BUTTON, REAR PANEL (SMALL)
12895	PLUG BUTTON, CASE SIDE
45024	BASE-PLATE FOOT

CASE LIGHTING

THE SCREW-TYPE TERMINAL BLOCK, FOUND IN THE RECESSED COMPARTMENT AT THE REAR OF FLUSH CASES, IS MADE ACCESSIBLE FOR THE EXTERNAL CONNECTION OF A REMOTE LIGHT SWITCH. THE INTERNAL LAMP IS NORMALLY WIRED FOR CONTINUAL ILLUMINATION AS LONG AS POWER IS APPLIED THROUGH THE AMPHENOL CONNECTOR. BY REMOVING THE ELECTRICAL JUMPER FROM SCREW TERMINALS 3 AND 4 AND WIRING A SINGLE-POLE, SINGLE-THROW SWITCH BETWEEN SOCKET TERMINALS 1 AND 4, THE LAMP MAY BE TURNED OFF AND ON REMOTELY (SEE FIG. B1 BELOW).

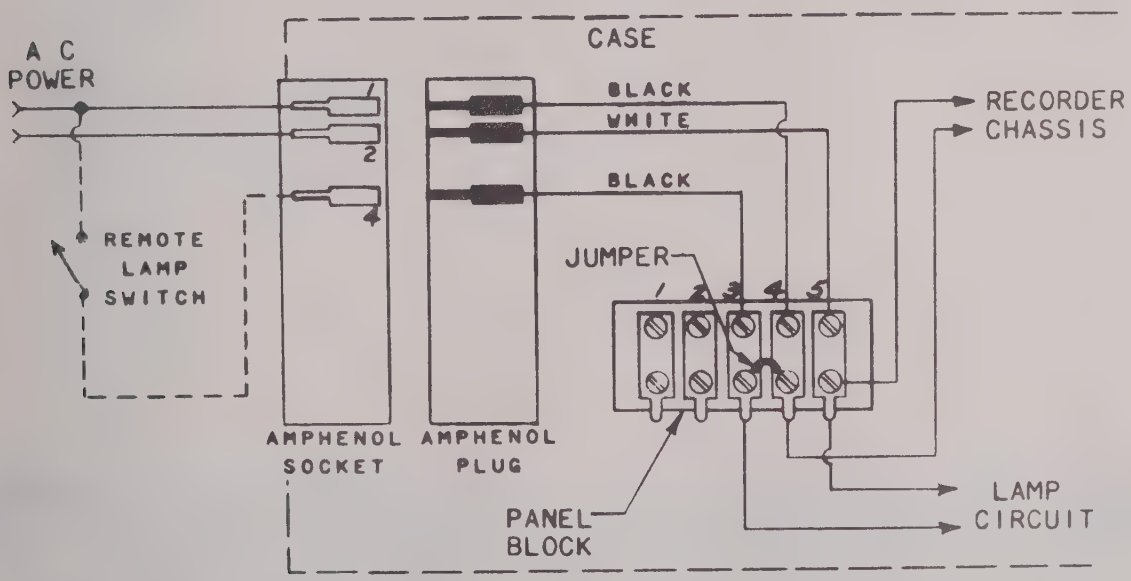


FIG. B1

OPERATING PROCEDURES

Before attempting to operate the EventGraph, see that all items are unpacked and that all shipping materials are removed from the instrument. Install an EA thermal-type chart in the recorder by following procedures given in Instruction Section C. After installing chart, proceed with the following steps:

(1) Turn on STYLUS HEAT switch (Fig. B2).

(2) After 5-second warm-up, turn on chart drive.

(3) Adjust STYLUS HEAT control for desired line contrast (Fig. B2).

> NOTE: This is a screwdriver adjustment on all flush models.

(4) Check writing characteristics of styluses by energizing electromagnets with chart in motion.

> NOTE: To prevent styluses from sticking to chart paper, always turn off heat switch 5 or 10 seconds before stopping chart drive.

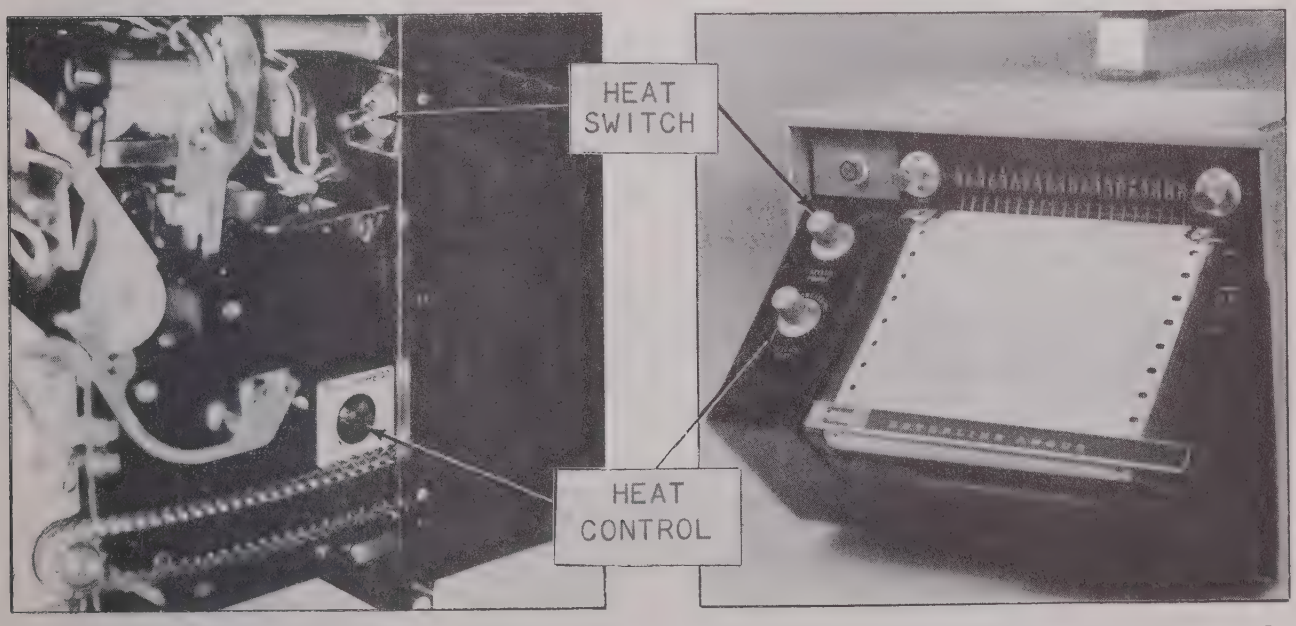
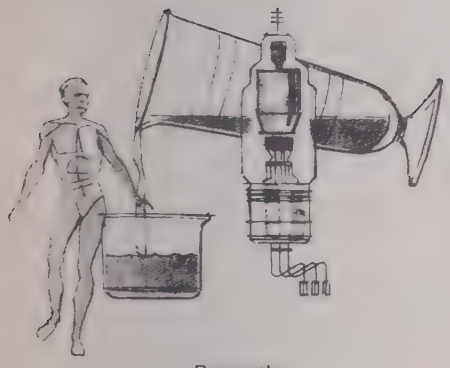
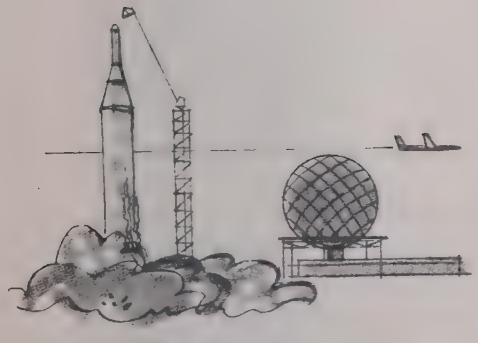


Fig. B2.

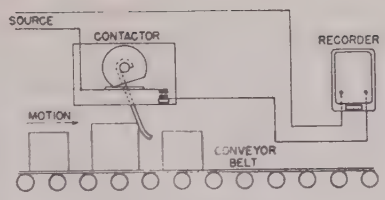
Production



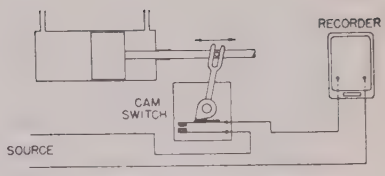
Research



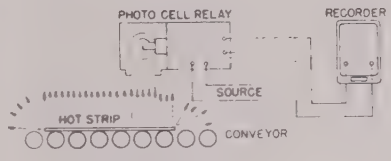
Exploration



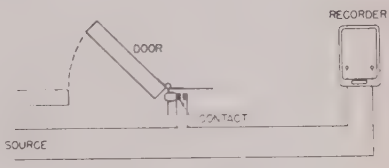
PHYSICAL CONTACT



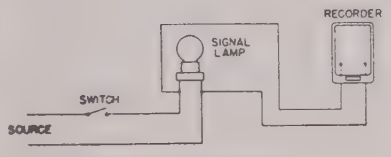
RECIPROCATING MOTION



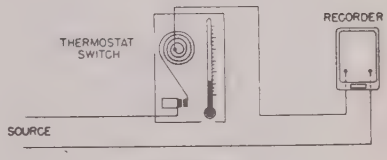
PRESENCE OF LIGHT



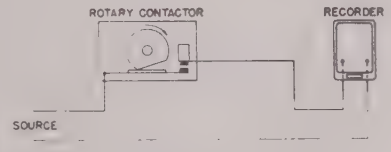
POSITION



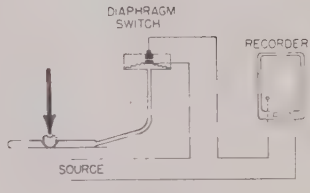
APPLICATION OF POTENTIAL



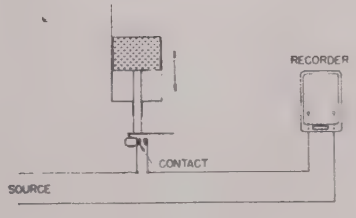
TEMPERATURE



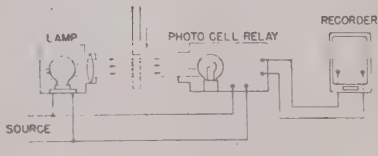
ROTARY MOTION



PRESSURE



WEIGHT OR FORCE



PRESENCE OF AN OPAQUE BODY

FIG. B3. SHOWN ABOVE ARE ONLY A FEW OF MANY METHODS THAT MAY BE USED TO ACTUATE EVENTGRAPH RECORDERS.

GENERAL APPLICATIONS

ANY ELECTRICAL, MECHANICAL, OR PHYSIOLOGICAL EVENT THAT CAN BE REPRESENTED BY AN OFF-ON CONDITION MAY BE RECORDED ON THE EVENTGRAPH. EVENTS ARE RECORDED BY OPENING OR CLOSING EXTERNAL CIRCUITRY CONNECTED TO THE RECORDER. THE PHENOMENON TO BE STUDIED MAY, HOWEVER, BE MECHANICAL OR PHYSIOLOGICAL IN NATURE RATHER THAN ELECTRICAL; IN THIS CASE, SWITCHES OR CONNECTORS OF SOME SORT MUST BE USED TO CONVERT THE PHENOMENON INTO ELECTRICAL IMPULSES. SEVERAL BASIC APPLICATIONS ARE ILLUSTRATED IN FIG. B3.

VARIOUS SWITCHES, RELAYS, AND CONTACT-MAKING DEVICES ARE COMMERCIALLY AVAILABLE FOR APPLICATION WITH PHYSICAL MOVEMENT. SOME OF THESE ARE CAM TYPES, CENTRIFUGAL TYPES, EXTENDED-LEVER TYPES, AND BRUSH OR FINGER TYPES. WHERE PHYSICAL CONTACT WITH AN OBJECT IS IMPOSSIBLE, PHOTO-ELECTRIC RELAYS MAY BE USED AS EVENT COUNTERS. SINCE A PHOTO-CELL CIRCUIT CAN BE MADE TO RESPOND TO THE PRESENCE OR ABSENCE OF LIGHT, IT MAY BE USED TO INDICATE THE PRESENCE OF A FLAME, A GLOWING OBJECT, OR THE ON--OFF CONDITION OF ANY LIGHT SOURCE. SWITCHES ARE AVAILABLE THAT WILL CLOSE ELECTRICAL CONTACTS WHEN A DESIRED PRESSURE OR VACUUM EXISTS. THERMOSTATS, TIMERS, FLOAT SWITCHES, AND MANY OTHER DEVICES ARE AVAILABLE TO CONVERT A PHENOMENON STIMULUS INTO ELECTRICAL IMPULSES. THE IMPULSES ARE THEN APPLIED TO THE EVENT RECORDER AND AN INTELLIGIBLE RECORD IS OBTAINED.

METHODS OF ACTUATING THE ELECTROMAGNETS WILL DEPEND UPON THE TYPE OF INSTRUMENT SELECTED. THERE ARE THREE BASIC TYPES AVAILABLE: A VOLTAGE TYPE WITH COMMON RETURN CONNECTIONS, A VOLTAGE TYPE WITH ISOLATED OR SEPARATE-RETURN CONNECTIONS, AND A SWITCH TYPE WITH A COMMON RETURN CIRCUIT FOR ALL ELECTROMAGNETS. IN A VOLTAGE-TYPE COMMON-RETURN INSTRUMENT, ONE SIDE OF ALL ELECTROMAGNET COILS IS CONNECTED TO A COMMON LEAD WHICH MAY BE TERMINATED IN ONE OR MORE PIN CONNECTIONS AT THE REAR OF THE INSTRUMENT. THE OTHER SIDE OF EACH COIL IS TERMINATED AT INDIVIDUAL PIN CONNECTIONS, WHICH ARE CONNECTED TO INDIVIDUAL IMPULSE SOURCES. THIS TYPE OF INSTRUMENT WILL FREQUENTLY BE USED IN THE STUDY OF TIMING CYCLES FOR A NUMBER OF AUTOMATICALLY CONTROLLED PROCESSES.

WHERE THE CONDITION OR PHENOMENON TO BE RECORDED IS MECHANICAL RATHER THAN ELECTRICAL, SWITCHES OR CONNECTORS MAY BE USED TO INTERRUPT AN EXTERNAL VOLTAGE SOURCE, AND THUS CONVERT THE CONDITION TO ELECTRICAL IMPULSES. THE CONTACT-MAKING DEVICE MAY BE OPERATED FROM MECHANICAL ROTATION OR THRUST, FROM CHANGING POSITION, OR FROM CHANGES IN PRESSURE, TEMPERATURE, OR LIGHT INTENSITY.

IN THE VOLTAGE-TYPE SEPARATE-RETURN INSTRUMENTS, EACH SIDE OF THE ELECTROMAGNET COIL IS TERMINATED AT AN INDIVIDUAL PIN CONNECTION ON THE REAR OF THE INSTRUMENT. THIS TYPE OF RECORDER IS USED WHERE THE ELECTROMAGNET CIRCUITS MUST NOT BE INTERCONNECTED. THE USE OF THIS TYPE OF RECORDER WILL OFTEN ELIMINATE THE NEED FOR DETERMINING POLARITIES AND SIMPLIFIES INSTALLATION.

In certain applications when an external switch is open, a potential may still remain on the lead connected to the electromagnet. Such a safety hazard can usually be avoided by using the separate-return type instrument.

The switch-type instrument is used where the recorded event mechanically actuates a switch or connector. There must be no voltage existing in the individual event circuits. An external step-down transformer is used to supply approximately 24-volts AC to actuate the electromagnets. One side of the secondary of this transformer is connected to one side of each coil within the instrument, and the other side of the secondary is connected in series with the external switches. The switches are individually connected to the electromagnets within the recorder. Some applications of the switch-type instrument are the recording of movements, the productive and idle time of machinery, the passage of objects on a conveyor, the flow of liquid, and the revolution of a shaft.

Either the switch-type or voltage-type of recorder may be used where switches, contacts, or relays operate the electromagnets and where the source is AC. The use of the switch type, however, permits lower operating voltages which makes possible a reduction in wiring costs, and also eliminates the hazards of high voltages. The voltage-type recorder must be used when only DC voltage is available.

There are some applications where the applied voltage may vary over too wide a range for satisfactory operation of a voltage--type recorder, or where currents are too large to be brought directly to the instrument. In such instances, appropriate relays should be connected into the circuits to provide the necessary on-off impulses.

In all applications of EventGraphs, it is essential that the instrument respond only when the desired action takes place. This may involve the fulfilling of two or more conditions simultaneously. In such cases, two or more switches may be used in series; the electromagnet being energized only when both switches are closed.

In other applications it may be desirable to total the number of events for a certain period of time. This function may be obtained automatically by connecting a counter in parallel with each electromagnet of a voltage-type recorder. An alternate method would be to connect a self-starting synchronous clock in place of the counter; the clock will run only when the electromagnet is energized, and will thus totalize the number of events.

Interpreting Records

There are three basic record patterns that may be obtained with the EventGraph. These types are the rectangle, band, and impulse patterns, shown in Fig. B4. The characteristics of each will depend upon the following relations: Length of time the pen is energized, the time the pen is de-energized, and the chart speed.

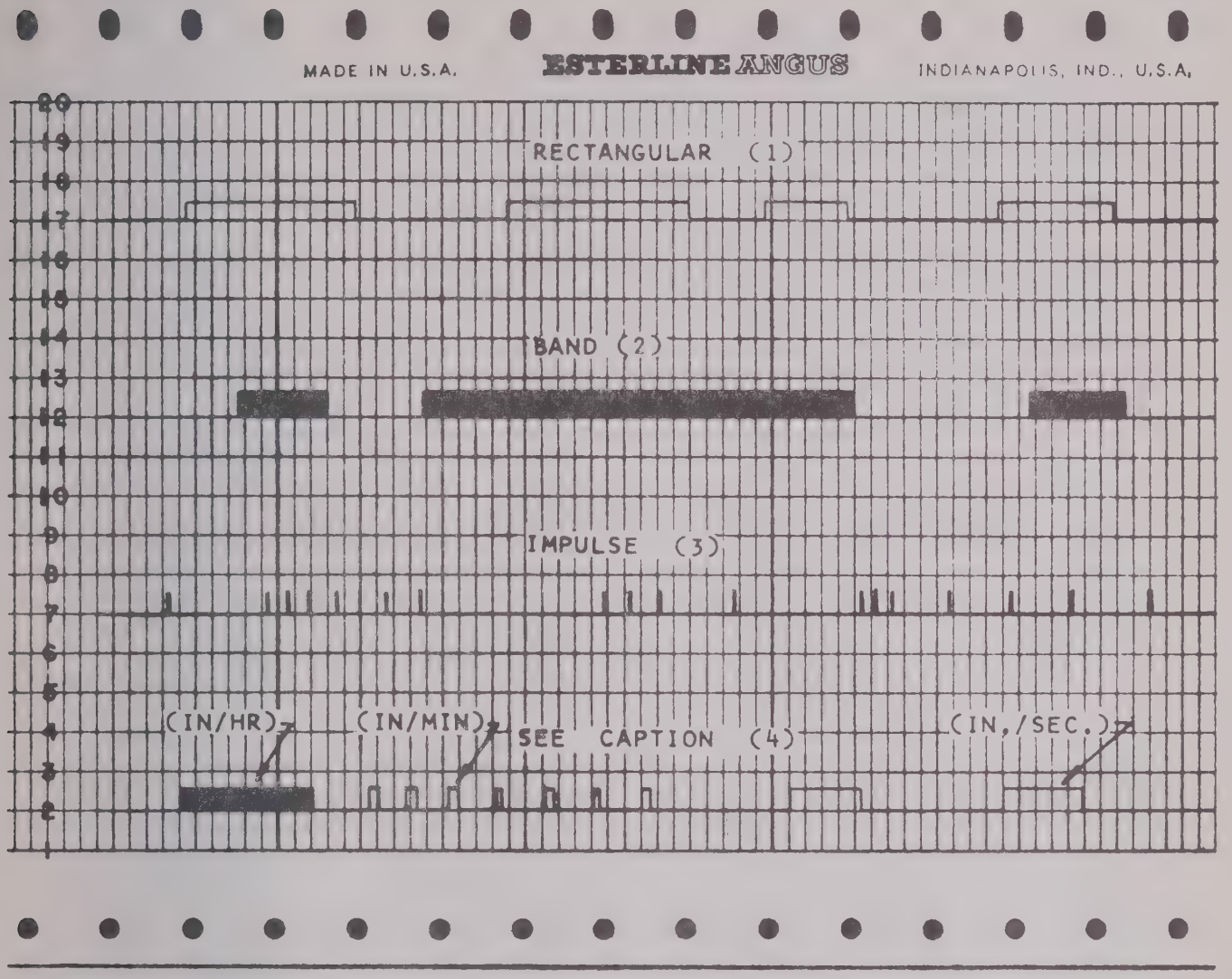


FIG. B4. EVENT RECORDER PATTERNS.

(1) USE OF THIS PATTERN PERMITS DETAILED EXAMINATION OF START AND FINISH FOR EACH EVENT.

(2) THIS PATTERN IS OFTEN USED TO RECORD LONG CYCLING PERIODS OF A NUMBER OF EVENTS AT SLOW CHART SPEEDS.

(3) RELIABLE IMPULSE PATTERNS CAN BE OBTAINED WITH 15-MILLI-SECOND PULSES AND UP TO A REPETITION RATE OF 10-PULSES PER SECOND.

(4) THIS COMBINATION PATTERN SHOWS HOW AN EVENT INDICATION MAY BE EXPANDED BY INCREASING CHART SPEED.

THE MOST COMMON TYPE OF RECORD IS THE RECTANGULAR PATTERN. IN THIS INSTANCE, THE ELECTROMAGNET IS ENERGIZED ONLY WHEN SOME EVENT CONDITION OCCURS; ENERGIZING TIME BEING LONG ENOUGH FOR THE PEN TO PRODUCE A CLEARLY-DEFINED RECTANGLE ON THE CHART. ALTHOUGH THE CHART SPEED IS NOT CRITICAL, SPEEDS SHOULD BE EMPLOYED THAT ARE NO HIGHER THAN NECESSARY TO OBTAIN THE REQUIRED ACCURACY IN TIME MEASUREMENTS.

A BAND TYPE RECORD MAY BE PRODUCED BY HAVING THE RECORDER PEN ACTUATED BY RAPIDLY-CHANGING EVENTS OR BY RUNNING THE CHART AT A VERY SLOW SPEED. CHART SPEED AND METHOD OF ACTUATION SHOULD BE CHOSEN SO THAT THE CYCLE OCCURS WITH ENOUGH RAPIDITY (IN COMPARISON TO CHART TRAVEL) TO CAUSE THE PEN TO PRODUCE OVER-LAPPING MARKS. THERE SHOULD NOT BE LESS THAN 80 STROKES AND NOT MORE THAN 200 STROKES OF THE PEN PER-INCH OF CHART IN THE BAND PATTERN.

AN IMPULSE PATTERN IS OBTAINED WHEN THE PEN IS ENERGIZED ONLY MOMENTARILY. THE RETURN STROKE OF THE PEN FALLS ON PRACTICALLY THE SAME PATH AS THE ACTIVE STROKE, SO THAT EACH EVENT PRODUCES A SINGLE LINE ON THE CHART. THE NUMBER OF MARKS PER GIVEN TIME, AND THE SPACING BETWEEN THEM, MAY BE ACCURATELY DETERMINED. WHEN IT IS DESIRED TO COUNT INDIVIDUAL EVENTS, THERE SHOULD BE NOT MORE THAN 30 STROKES OF THE PEN PER-INCH OF CHART PAPER.

IN SOME APPLICATIONS, IT MAY BE DESIRABLE TO DISPLAY A COMBINATION OF PATTERNS TO PROPERLY ANALYZE A CERTAIN EVENT. AS SHOWN IN THE COMBINATION PATTERN OF FIG. B-4, ONE TYPE OF RECORD CAN OFTEN BE CONVERTED TO ANOTHER BY CHANGING CHART SPEEDS. AN OPERATOR MAY BE RECORDING AN EVENT FOR A LONG PERIOD USING A BAND PATTERN, BUT THEN CHOOSE TO EXAMINE INDIVIDUAL STROKES OF THE PEN MORE CLOSELY. IN MOST CASES, HE WILL BE ABLE TO OBTAIN EITHER AN IMPULSE OR RECTANGULAR PATTERN BY MERELY INCREASING CHART SPEED. THE VARIOUS PATTERNS MAY REPRESENT A COMPLEX PROCESS OR SYSTEMS CYCLING WHERE THE TIME FOR INDIVIDUAL EVENTS CAN BE DETERMINED OR TOTALIZED.

ONE TYPE OF GRAPHIC PATTERN PRODUCED BY SEVERAL DIFFERENT EVENT CONDITIONS MAY BE INTERRUPTED BY ANOTHER TYPE OF PATTERN IN ORDER TO IDENTIFY TIME PERIODS FOR INDIVIDUAL EVENTS. THE TYPE OF PATTERN SELECTED WILL, OF COURSE, DEPEND UPON THE PARTICULAR APPLICATION AND NATURE OF RECORDING DATA DESIRED.

TO PREVENT FALSE RECORDS, BOTH CURRENT AND VOLTAGE RELAYS MAY BE USED TO ENERGIZE AN EVENT PEN. SPECIAL SHIELDING OR FILTERING MAY ALSO BE NECESSARY TO ELIMINATE EXTERNAL INTERFERENCE OR INTER-ACTION BETWEEN EVENT CIRCUITS.

MAINTENANCE

EventGraph recorders are of sturdy construction and are designed for long trouble-free operation. Nevertheless, they should receive the care afforded any precision piece of equipment. In the few cases where trouble may occur, it is recommended that the entire instrument be returned to the factory, rather than to attempt any major repairs in the field. Should adjustment or minor service become necessary in the field, refer to the following procedures.

> WARNING: Recorders connected to electrical circuits may be hazardous. To prevent accidental shock, always remove power from the instrument before disassembling or servicing.

ADJUSTMENTS

All inkless recorders are carefully setup for standard operation before leaving the factory; however, certain field adjustments are made possible to satisfy unusual applications and individual preferences. In order to properly evaluate results of these adjustments, the chart should be running and styluses cycled so that both forward and lateral writing characteristics may be observed.

- Heat Control ---- Temperature of the writing elements is made variable by a rheostat which is connected in series with the stylus-heating circuit. When the control is rotated in a clockwise direction, temperature of the styluses will increase and the recorded lines on the chart will become darker. To reduce stylus temperature, and consequently lighten the recorded lines, the control is rotated counterclockwise. It is recommended that this control remain near its maximum clockwise position for optimum line perception.

- Stylus Pressure ---- Pressure of the styluses on the chart paper is made variable by the screwdriver adjustments shown on the assembly drawing. When stylus pressure is decreased, the recorded lines will appear wider; when pressure is increased, the lines will become narrower. This adjustment is pre-set at the factory and will not require field attention ---- unless the stylus mounting assembly has been removed from the chassis.

  Recommended procedures for adjusting pressure are as follows: Turn on the instrument and set the heat control to minimum (fully counterclockwise). Loosen the two adjustment screws and position the entire writing head so that all styluses are producing fine lines on the chart paper and are properly recording all lateral movements. Advance the heat control if lines are not clearly visible. If pressure is too light, the styluses will produce wide, blurry lines. If pressure is too heavy, the styluses will tend to drag and not completely respond to lateral movements.

AFTER THE REQUIRED PRESSURE IS OBTAINED, TIGHTEN THE SCREWS, ADVANCE THE HEAT CONTROL, AND CHECK OPERATION AT THE DESIRED CHART SPEED. IF INDIVIDUAL LATERAL LINES APPEAR TO RUN TOGETHER AT SLOW CHART SPEEDS, REDUCE THE SETTING OF THE HEAT CONTROL AS REQUIRED.

- TRACKING ---- NORMALLY, THE WRITING ELEMENTS WILL RECORD ON THEIR RESPECTIVE CHART REFERENCE LINES; HOWEVER, IF ALL STYLUSES ARE NOT TRACKING AS DESIRED, THE LATERAL POSITIONING SCREWS, SHOWN ON THE ASSEMBLY DRAWING, MAY BE LOOSENED AND THE WRITING HEAD SHIFTED TO THE RIGHT OR LEFT. WHEN MAKING THESE ADJUSTMENTS ALWAYS MAINTAIN A SMALL GAP BETWEEN ARM AND ARMATURE AT THE REAR OF EACH ELECTROMAGNET -- AS ILLUSTRATED IN FIG. B5.

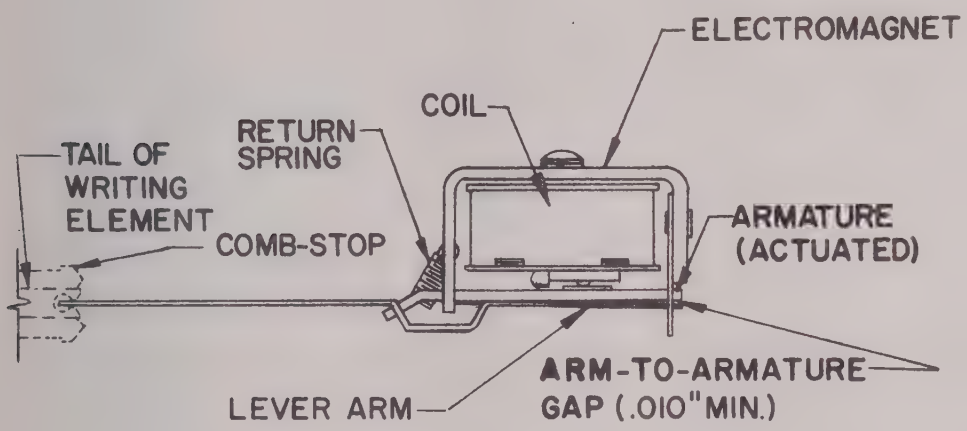


FIG. B5. WRITING ELEMENT ACTUATING ASSEMBLY

IF ONLY CERTAIN STYLUSES FAIL TO TRACK THEIR REFERENCE LINES, TURN OFF THE HEATING CIRCUIT AND CAREFULLY BEND THE END OF EACH DISPLACED ELEMENT UNTIL PROPER ALIGNMENT IS ACHIEVED. SHOULD TRACKING DIFFICULTY PERSIST AFTER MAKING THE ABOVE ADJUSTMENTS, RETURN THE INSTRUMENT TO THE FACTORY FOR SERVICE.

> WARNING: AVOID DIRECT CONTACT WITH THE HEATED STYLUS TIPS WHEN MAKING ADJUSTMENTS.

DISASSEMBLY

IT IS NOT RECOMMENDED THAT THE ELECTROMAGNET ASSEMBLY BE REMOVED FROM THE INSTRUMENT IN THE FIELD. IF THIS OPERATION BECOMES NECESSARY FOR CLEANING OR MINOR REPAIRS, HOWEVER, PROCEED WITH THE FOLLOWING STEPS:

(1) TURN OFF CHART DRIVE AND STYLUS HEAT SWITCH.

(2) EXPOSE RECORDER CHASSIS BY FOLLOWING INSTRUCTIONS IN SECTION A OF THIS MANUAL.

(3) Remove two mounting screws from each side of chassis (see assembly drawing).

(4) Lift electromagnet assembly up and out of chassis. Assembly may be tilted back or laid to one side of the chassis with wiring harness connected.

When replacing this assembly, see that styluses are correctly positioned across center of drive roller and adjust pressure and tracking.

> WARNING: To prevent accidental shock, always remove power from the instrument before disassembling or servicing.

TROUBLESHOOTING

If it is suspected that the writing elements are not recording properly, the following service procedures are recommended:

(1) See that heat switch is on and that heat control is correctly adjusted.

(2) Clean stylus tips and see that writing head is correctly mounted.

(3) If styluses are out of alignment, follow instructions in this section under ADJUSTMENTS.

(4) Check all external connections to see that they are clean and tight.

(5) See that chart transport is securely latched in operating position.

(6) Measure actuating voltages applied to the inputs of the recorder. Values should be within ± 15% of electromagnet ratings.

(7) Expose recorder chassis by following instructions in Section A of this manual.

(8) Carefully clean all dirt from chassis components and inspect electrical wiring.

(9) Check DC resistance of components in electromagnet and stylus-heat circuits.

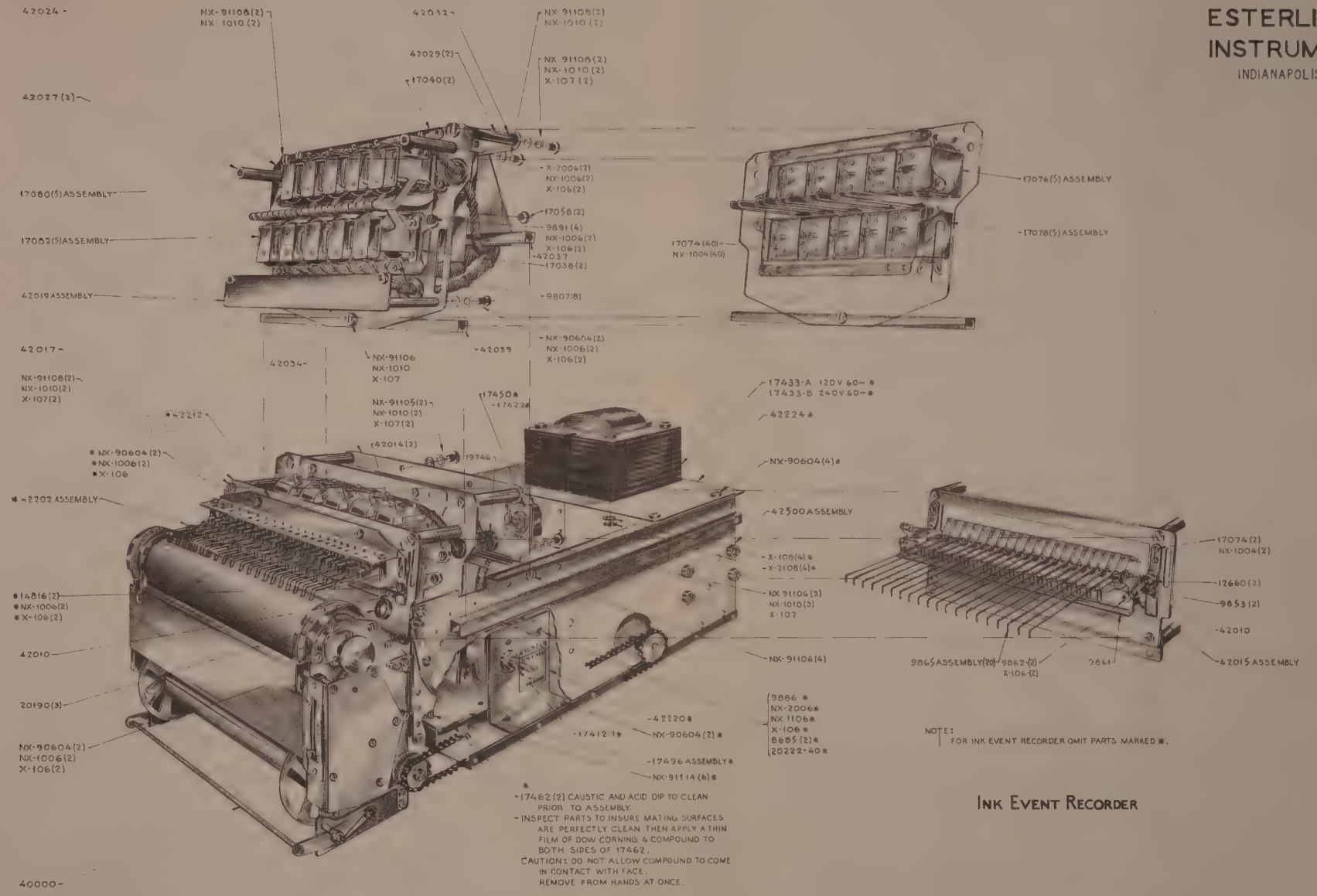
> NOTE: If above steps fail to isolate trouble, return instrument to factory for service.

REPLACEMENT PARTS

All parts for the recorder are available directly from Esterline Angus Instrument Company. When ordering parts, always give part numbers and the instrument serial number. Refer to the assembly drawing in this manual for parts identification.

ESTERLINE ANGUS INSTRUMENT Co. Inc.

INDIANAPOLIS, INDIANA U.S.A.



* 17462(2) CAUSTIC AND ACID DIP TO CLEAN PRIOR TO ASSEMBLY.
- INSPECT PARTS TO INSURE MATING SURFACES ARE PERFECTLY CLEAN THEN APPLY A THIN FILM OF DOW CORNING 4 COMPOUND TO BOTH SIDES OF 17462.
CAUTION: DO NOT ALLOW COMPOUND TO COME IN CONTACT WITH FACE. REMOVE FROM HANDS AT ONCE.

NOTE: FOR INK EVENT RECORDER OMIT PARTS MARKED *.

THERMAL EVENT RECORDER

INK EVENT RECORDER

42000

ESTERLINE ANGUS INSTRUMENT CO., INC. INDIANAPOLIS, IND. U.S.A.			
NAME	EVENT RECORDER ASSEMBLIES		
SCALE NONE			
8-21-63	NO. 42000		

SECTION C

CHART DRIVE INSTRUCTIONS FOR SERIES "S" LABGRAPH RECORDERS

To produce useful graphic records, a recording instrument must not only incorporate a precision measuring element but also an accurate and reliable chart-propelling mechanism. The chart drive must have enough power to unwind, propel, and rewind the chart paper; and, like a fine watch, it must also function consistently under various environmental conditions. Esterline Angus chart drives have been meeting these rigid requirements for over half a century.

In addition to accuracy and reliability, the Series "S" chart drives offered in LabGraph recorders are designed with versatility and portability in mind. "Up-front" controls, a tilt-down transport, and slanted writing table are some of the convenient features found in this new bench model. These chart drives also have provisions for selecting different chart speeds without manually changing gears.

The Series "S" chart drives will not become obsolete when unpredictable applications of the future are encountered. Each system is modular in nature, and one style of drive may be converted to another by adding or removing components (consult factory for details).

Series "S" chart drives are offered in single speed as well as multiple speeds to meet all applications of the user. Several standard designs are given in the following table.

PRINCIPLE OF OPERATION

THE CHART DRIVE IS AN ELECTRO-MECHANICAL DEVICE THAT CONVERTS ELECTRICAL ENERGY INTO LINEAR PHYSICAL MOTION THROUGH THE USE OF A MOTOR POWER SOURCE AND VARIOUS GEAR ASSEMBLIES. THE BLOCK DIAGRAM OF FIG. C1 ILLUSTRATES AN ENTIRE CHART DRIVE SYSTEM. THE BLOCKS ENCIRCLED BY BROKEN LINES ARE OPTIONAL COMPONENTS, AND THEIR USE WILL DEPEND UPON THE PARTICULAR STYLE OF DRIVE SELECTED.

THE MOTOR DRIVE ASSEMBLY (FIG. C1) CONSISTS OF A SYNCHRONOUS MOTOR AND REDUCTION GEAR HEAD. THE SYNCHRONOUS MOTOR MUST BE OPERATED FROM A FREQUENCY-REGULATED SOURCE OF A. C. POWER. THE GEAR HEAD PROVIDES A 60-TO-1 SPEED CHANGE. WHEN THIS FEATURE IS USED, THE OPERATOR MAY SELECT EITHER HOUR OR MINUTE SPEEDS FROM A FRONT-PANEL KNOB, OR BY USE OF A REMOTE SWITCH.

THE OUTPUT SHAFT OF THE GEAR HEAD POWERS THE CHART DRIVE TRANSMISSION, WHICH MAY BE EITHER A SINGLE-SPEED OR MULTIPLE-SPEED TYPE. IN THE MULTIPLE TYPE, SPEED IS VARIED BY A UNIQUE SYSTEM OF CAM-OPERATED GEARS AND OVER-RUNNING CLUTCHES. CHART FEED RATES ARE MANUALLY SELECTED BY THE FEED-RATE SELECTOR LOCATED ON THE FRONT PANEL. THE OUTPUT SHAFT OF THE TRANSMISSION IS ALWAYS ENERGIZED AND THEREFORE "MESH-TIME" IS NEGLIGIBLE -- EVEN AT SLOW SPEEDS.

CHART FEED RATES HIGHER THAN 12-INCHES PER MINUTE ARE OBTAINED BY THE ADDITION OF A SECOND-SPEED ATTACHEMENT — CONSISTING OF A SEPARATE SYNCHRONOUS MOTOR AND SPECIAL HIGH-SPEED TRANSMISSION. THIS ATTACHMENT IS ELECTRICALLY ACTUATED BY A SPEED CONTROL KNOB ON THE FRONT PANEL OF THE INSTRUMENT, OR THROUGH THE USE OF AN EXTERNAL REMOTE SWITCH. THE MAXIMUM CHART FEED RATE OBTAINABLE WITH THIS ATTACHMENT IS 6-INCHES PER SECOND OR 30-FEET OF CHART PER MINUTE.

THUS FAR, WE HAVE DISCUSSED ONLY THOSE COMPONENTS OF THE CHART-DRIVING MECHANISM WHICH ARE PHYSICALLY POSITIONED AT THE REAR OF THE RECORDER CHASSIS. SINCE THE CHART TRANSPORT ASSEMBLY IS FOUND ON THE FRONT OF THE CHASSIS, A SPECIAL DRIVE COUPLING IS EMPLOYED. THE DRIVING MECHANISM IS COUPLED TO THE CHART TRANSPORT BY A CHAIN AND SPROCKET ARRANGEMENT THAT MAINTAINS CONSTANT SPEED AND ACCURATE TIMING THROUGHOUT THE SYSTEM.

A PRECISION GEAR TRAIN IN THE TRANSPORT ASSEMBLY UNWINDS THE CHART PAPER FROM A SUPPLY ROLL, PROPELS IT OVER A DRIVE ROLLER AND REWINDS IT ON A REROLL ARBOR. THE DRIVE ROLLER HAS A NUMBER OF FORMED PINS AT EACH END WHICH ENGAGE MARGINAL PERFORATIONS IN THE PAPER AND FEEDS THE CHART UNDER THE WRITING ELEMENT SMOOTHLY AND AT A CONSTANT RATE. A TIME-SET KNOB IS ALSO PROVIDED ON THE RIGHT END OF THE DRIVE ROLLER FOR MANUALLY ADVANCING THE CHART PAPER AND SETTING IT TO TIME. IN ADDITION, AN OVER-RUNNING CLUTCH IN THE REROLL ASSEMBLY MAINTAINS PROPER TENSION ON THE CHART PAPER AT ALL TIMES.

THE TRANSPORT ASSEMBLY ON ALL SERIES "S" CHART DRIVES INCORPORATES A CHART-SUPPLY INDICATOR. THIS SMALL GAGE TELLS THE OPERATOR AT A GLANCE THE AMOUNT OF CHART PAPER REMAINING ON THE SUPPLY ROLL. RELOADING IS MADE EASY BY A SPECIAL TILT-DOWN TRANSPORT WHICH IS AN EXCLUSIVE FEATURE ON ALL LABGRAPH RECORDERS.

LABGRAPH CHART DRIVES ARE EQUIPPED WITH A SPECIAL INTERNAL CLUTCH SO THAT THE CHART MAY BE DRIVEN FROM AN EXTERNAL SOURCE. WHEN THE EXTERNAL SOURCE CAN REVERSE DIRECTION, A SEPARATE BACK-UP CLUTCH MUST BE INSTALLED IN THE SYSTEM. THE INTERNAL MECHANISM MAY ALSO BE USED TO DRIVE AN EXTERNAL DEVICE; IT IS NOT, HOWEVER, SUITABLE FOR TRANSMITTING A GREAT DEGREE OF TORQUE, AND WILL THEREFORE OPERATE SYNCHRONOUSLY ONLY UNDER LIGHT LOADS.

AN ACCESS HOLE IS PROVIDED ON THE SIDE OF THE LABGRAPH CASE FOR EXTERNAL CHART-DRIVE COUPLING. THE DRIVE SHAFT AT THIS POINT HAS A BALL AND CROSS-PIN FITTING. EXTERNAL DEVICES SHOULD BE ATTACHED TO THE FITTING BY MEANS OF A FLEXIBLE COUPLER (CONSULT FACTORY FOR ADDITIONAL DETAILS).

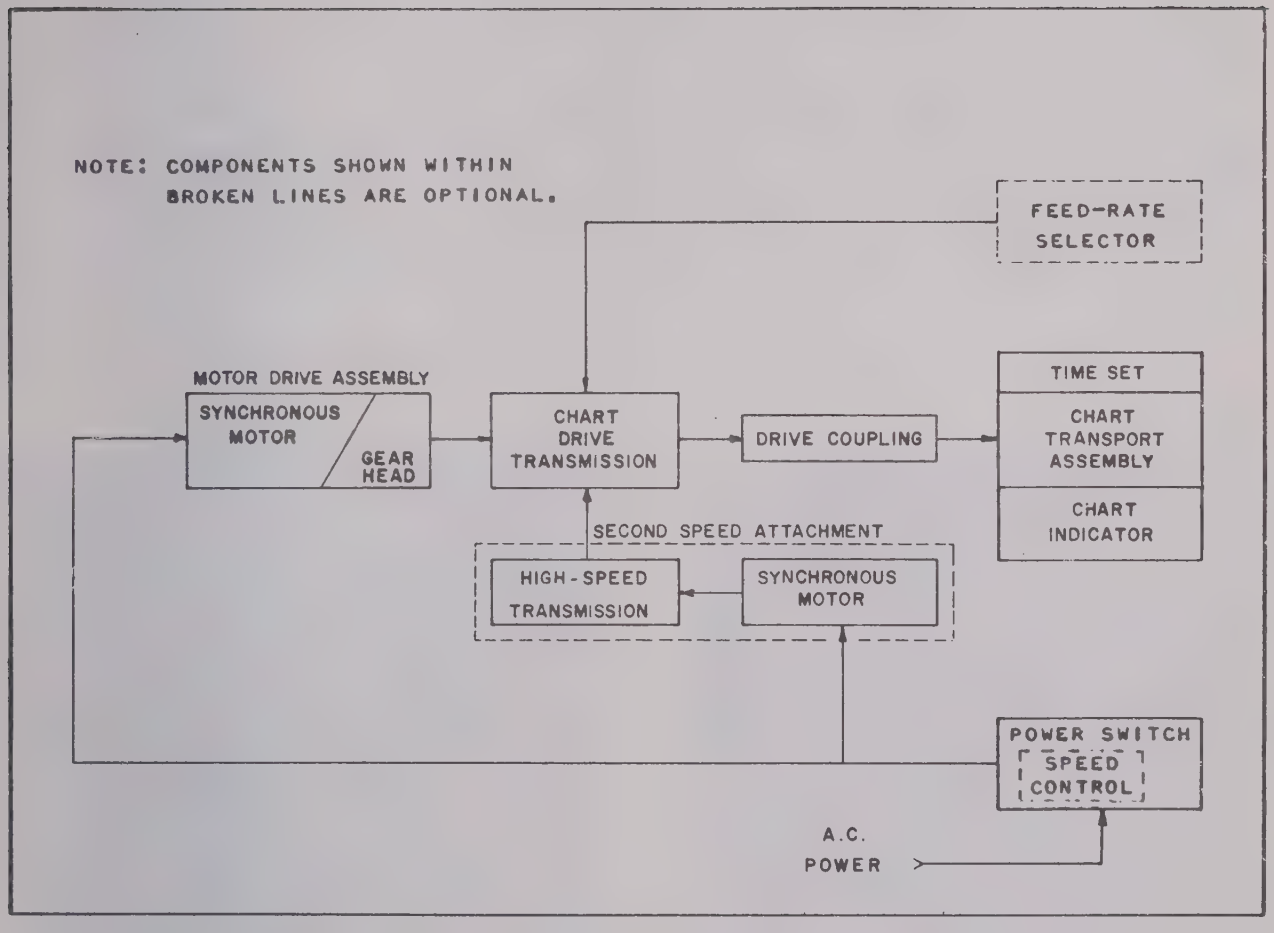


FIG. C1. BLOCK DIAGRAM OF CHART-DRIVE SYSTEM FOR SERIES "S" RECORDERS.

CHARTING PROCEDURES

FOLLOWING ARE INSTRUCTIONS FOR INSTALLING CHART PAPER IN SERIES "S", LABGRAPH RECORDERS. TO MAINTAIN GUARANTEED ACCURACY AND INSURE OPTIMUM PERFORMANCE, ALWAYS USE ESTERLINE ANGUS PRECISION CHARTS IN THIS INSTRUMENT. BEFORE PREPARING THE INSTRUMENT FOR OPERATION MAKE SURE THAT ALL PACKING MATERIALS ARE REMOVED, AND THAT THE INSTRUMENT IS RESTING ON A FIRM FLAT SURFACE. RAISE THE CASE LID AND SEE THAT CHART-DRIVE POWER IS OFF. IT IS ALSO RECOMMENDED THAT THE MEASURING ELEMENT(S) BE DE-ENERGIZED. PROCEED WITH THE CHARTING STEPS IN THE FOLLOWING ORDER --------

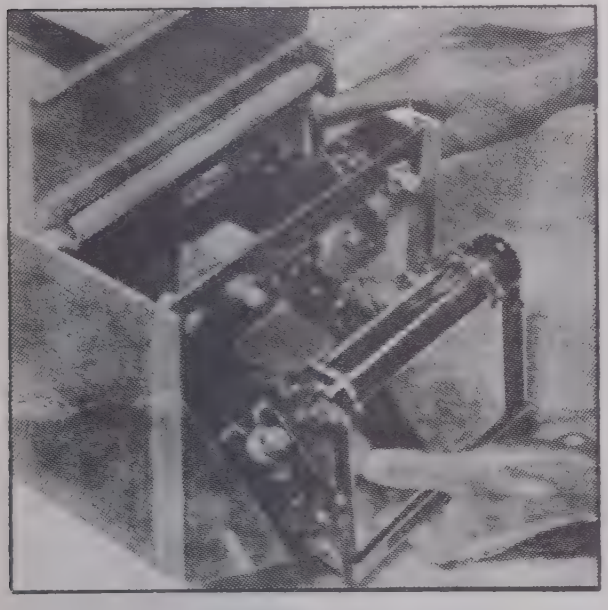


FIG. C2. PERMIT TRANSPORT ASSEMBLY TO TILT DOWN BY PRESSING LEVER ON RIGHT SIDE OF CASE AS SHOWN.

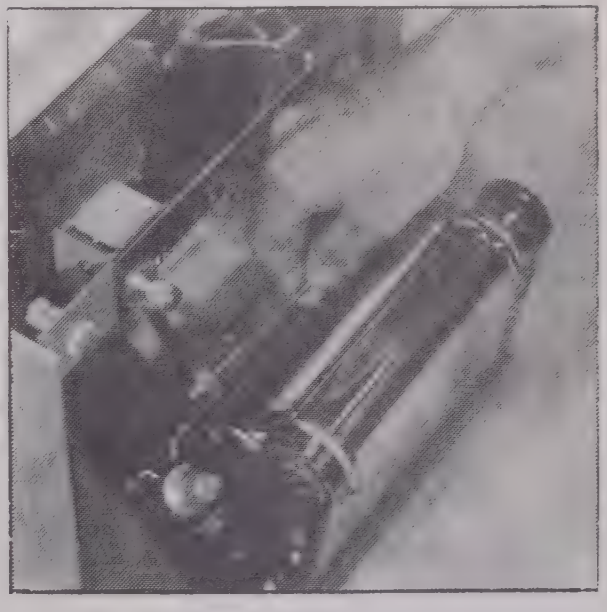


FIG. C3. REMOVE SUPPLY ROLL ARBOR BY PUSHING BACK AND LIFTING STRAIGHT UP. CENTER PAPER ROLL ON ARBOR (ELONGATED PERFORATIONS TO RIGHT) AND SNAP LOADED ARBOR BACK INTO TRANSPORT.

CONTINUED---

CONT'D. FROM PAGE C-6

FIG. C4. TEAR OR CUT END OF PAPER TO "V"; TURN UP POINT SLIGHTLY AND FEED UNDER HOLD-DOWN BAR AND OVER TOP OF DRIVE ROLLER. TURN TIME-SET KNOB SO ROLLER PINS ENGAGE CHART PERFORATIONS.

FIG. C5. SWING TRANSPORT UP TO OPERATING POSITION. OPEN DOOR AT BOTTOM OF TRANSPORT AND REMOVE REROLL CYLINDER BY LIFTING UP, THEN DOWN AND OUT AS SHOWN. KEEP CYLINDER STRAIGHT WHEN REMOVING OR INSTALLING.

FIG. C6. HOLDING CYLINDER WITH GEAR END TO RIGHT, INSERT CHART INTO SLOT AND SLIDE PAPER-GUIDE DISK ON GEAR END OF CYLINDER OUTWARD. ROLL SEVERAL TURNS ON CYLINDER AND SLIDE GUIDE DISK INWARD JUST TO EDGE OF PAPER.

FIG. C7. SNAP REROLL BACK INTO TRANSPORT. TAKE UP CHART SLACK BY ROTATING DISK ON LEFT END OF REROLL CYLINDER AS SHOWN. TURN ON CHART DRIVE AND CHECK OPERATION. CHART MAY BE SET TO ANY DESIRED POSITION BY TURNING THE TIME-SET KNOB.

OPERATION AND MAINTENANCE

SERIES "S" CHART DRIVES ARE SIMPLE TO OPERATE AND EASY TO MAINTAIN, BUT FAILURE TO FOLLOW RECOMMENDED PROCEDURES MAY RESULT IN UNSATISFACTORY OPERATION AND PERMANENT DAMAGE TO THE INSTRUMENT. NO ATTEMPT SHOULD ME MADE TO PUT THE RECORDER INTO OPERATION UNTIL ALL INSTRUCTIONS HAVE BEEN THOROUGHLY STUDIED.

CONNECTIONS AND ELECTRICAL RATINGS FOR THE CHART DRIVE SUPPLY ARE GIVEN ON THE "TERMINAL CODE PLATE", WHICH IS LOCATED ON THE REAR OF THE INSTRUMENT CASE. FOR HANDLING PROCEDURES OF THE WRITING ELEMENT(S), SEE INSTRUCTIONS IN SECTION B.

A CHART WITH PROPER RANGE AND TIME MARKINGS SHOULD BE INSTALLED IN THE TRANSPORT ASSEMBLY BY FOLLOWING THE CHARTING PROCEDURES GIVEN IN THIS SECTION. IF TIME MARKINGS ARE USED, THE CHART SHOULD BE SET TO THE DESIRED POSITION BY THE TIME-SET KNOB ON THE RIGHT END OF THE DRIVE ROLLER.

CONTROLS

CHART DRIVE CONTROLS ARE LOCATED ON THE SCALEPLATE PANEL DIRECTLY ABOVE THE CHART TRANSPORT ASSEMBLY. ALL CHART DRIVES WITH SINGLE-SPEED TRANSMISSIONS WILL HAVE AN OFF-ON SWITCH AT THE LEFT END OF THIS PANEL. FOR DRIVES PROVIDING BOTH SINGLE-HOUR AND SINGLE-MINUTE SPEEDS WITH ELECTRIC SPEED CONTROL, THE PANEL SWITCH WILL HAVE A THREE-POSITION SEQUENCE OF: OFF/HOUR/MINUTE. SINGLE FEED-RATE DRIVES PROVIDING HOUR-, MINUTE-, AND SECOND-SPEEDS WITH ELECTRIC SPEED CONTROL WILL HAVE A FOUR-POSITION SWITCH SEQUENCE OF: OFF/HOUR/MINUTE/SECOND.

ALL CHART DRIVES FEATURING MULTI-SPEED TRANSMISSIONS WILL ALSO HAVE A FEED-RATE SELECTOR SWITCH LOCATED AT THE RIGHT END OF THE SCALEPLATE PANEL. THIS SWITCH PERMITS THE OPERATOR TO SELECT ANY ONE OF FIVE DIFFERENT TRANSMISSION SPEEDS (OR CHART FEED RATES). THE CONTROL KNOB IS CALIBRATED IN INCHES, AND WILL NORMALLY HAVE A FIVE-POSITION SEQUENCE OF: .75, 1.5, 3, 6, AND 12. THE OPERATOR MAY ROTATE THIS PANEL KNOB IN EITHER DIRECTION TO SELECT THE DESIRED RATE OF FEED.

TO OPERATE A CHART DRIVE INCORPORATING A MULTI-SPEED TRANSMISSION WITH ELECTRIC SPEED CONTROL, THE KNOB ON THE LEFT OF THE PANEL IS PLACED IN THE DESIRED TIME-RATE POSITION (HR, MIN, OR SEC); AND THE KNOB ON THE RIGHT IS SET TO THE DESIRED CHART FEED RATE (IN INCHES). CHART SPEED MAY BE CHANGED AT ANY TIME BY RE-SETTING EITHER KNOB WITH THE CHART IN MOTION OR AT REST. TO STOP THE CHART PAPER, ROTATE THE SWITCH ON THE LEFT TO ITS "OFF" POSITION.

REMOTE CONTROL

EXTERNAL SWITCHES MAY BE USED WITH SERIES "C" RECORDERS TO REMOTELY ACTUATE ELECTRICAL CONTROLS OF THE CHART DRIVE. THIS INCLUDES OFF-ON AS WELL AS THE HOUR, MINUTE, AND SECOND FUNCTIONS OF THE SPEED CONTROL.

THE TYPE OF REMOTE SWITCH OR SWITCHES REQUIRED WILL DEPEND UPON THE NUMBER OF REMOTE FUNCTIONS DESIRED. IF THE RECORDER IS EQUIPPED WITH A REMOTE PROVISION, SEE THE SUPPLEMENTAL INSTRUCTIONS IN THIS MANUAL FOR CONNECTIONS AND OPERATING PROCEDURES.

RECORDING CHARTS

TO MAINTAIN INSTRUMENT ACCURACY AND TO INSURE OPTIMUM PERFORMANCE, ONLY ESTERLINE ANGUS PRECISION CHARTS SHOULD BE USED WITH THIS RECORDER. CHARTS WITH APPROPRIATE TIME MARKINGS ARE AVAILABLE FOR OPERATION WITH ANY CHART SPEED IN "INCHES PER HOUR". BLANK CHARTS AND THOSE WITHOUT TIME MARKINGS ARE AVAILABLE FOR INTERMITTENT OPERATION OR FOR APPLICATIONS WHERE OCCURRENCE TIME OF A VARIABLE IS NOT IMPORTANT. IN ADDITION TO THESE STOCK ITEMS, ESTERLINE ANGUS PRODUCES CUSTOMIZED CHARTS WITH SPECIAL RULINGS AND RANGE NUMBERS. CONSULT THE FACTORY OR YOUR LOCAL EA REPRESENTATIVE FOR ADDITIONAL INFORMATION ON THESE SPECIAL CHARTS.

THE CHART RECORD MAY BE INSPECTED AT ANY TIME DURING OPERATION BY UNWINDING THE PAPER FROM THE REROLL CYLINDER. WITH THE CHART DRIVE IN OPERATION, THE REROLL SYSTEM FUNCTIONS AT ALL TIMES AND WILL REROLL ANY PORTION OF CHART UNWOUND FOR INSPECTION. IF DESIRED, THE REROLL ACTION MAY BE SPEEDED-UP WITHOUT THROWING THE CHART OUT OF TIME BY HOLDING THE TIME-SET KNOB AND MANUALLY ROTATING THE DISK ON EITHER END OF THE REROLL CYLINDER. IF A LARGE PORTION OF CHART MUST BE REROLLED, THE CYLINDER SHOULD BE REMOVED AND THE CHART REROLLED BY HAND OR ON AN ESTERLINE ANGUS "CHART INSPECTOR".

INSTEAD OF REROLLING THE CHART PAPER ON THE REROLL CYLINDER, IT MAY BE FED OVER THE WRITING TABLE AND STRAIGHT OUT OF THE INSTRUMENT. IF FEEDING DIFFICULTY IS ENCOUNTERED AT FAST CHART SPEEDS, IT MAY BE NECESSARY TO PERMIT THE CHART TO FALL OVER THE EDGE OF A BENCH OR TABLE AND ATTACH A WEIGHT TO THE PAPER. A FIVE-OR SIX-OUNCE CLAMP-ON DEVICE IS SUFFICIENT FOR THIS PURPOSE. DO NOT PULL OR JERK ON THE CHART AS THIS MAY EITHER THROW IT OUT OF TIME, OR DISENGAGE IT FROM THE PINS ON THE DRIVE ROLLER. THE BAR AT THE BOTTOM OF THE WRITING TABLE MAY BE USED AS A TEAR-OFF EDGE BY PULLING THE CHART STRAIGHT UP FROM ONE SIDE TO THE OTHER.

IF CONTINUOUS RECORDS ARE DESIRED, BE SURE TO CHECK THE CHART INDICATOR REGULARLY. THE INDICATOR IS POSITIONED ON THE RIGHT SIDE OF THE WRITING TABLE SURFACE. AT THE TOP OF ITS SCALE IS FOUND THE LETTER "F" -- INDICATING A FULL CHART ROLL; AND, AT THE BOTTOM OF THE SCALE IS THE LETTER "E" -- INDICATING A NEAR EMPTY SUPPLY ROLL. IN ADDITION TO THIS AUTOMATIC INDICATOR, A WARNING

WILL APPEAR NEAR THE END OF EACH CHART ROLL WHICH INDICATES THAT ONLY A FEW FEET OF UNUSED CHART REMAIN.

CHART REMOVAL

A REROLLED CHART MAY BE REMOVED FROM THE INSTRUMENT BY PROCEEDING WITH THE FOLLOWING STEPS:

1) TURN OFF CHART DRIVE AND OPEN SMALL DOOR AT BOTTOM OF TRANSPORT.

2) GRASP CHART ON REROLL CYLINDER, LIFT UP, AND REMOVE FROM INSTRUMENT. KEEP ROLL STRAIGHT WHEN REMOVING.

3) REMOVE GEAR PLUG FROM RIGHT END OF REROLL CYLINDER.

4) SLIDE CHART ROLL FROM OPEN END OF CYLINDER. IF CHART IS TOO TIGHTLY WOUND, CAREFULLY TWIST PAPER ROLL COUNTER-CLOCKWISE AS IT IS BEING WITHDRAWN FROM CYLINDER. PLACE GEAR PLUG BACK INTO END OF CYLINDER -- MAKING SURE THAT SMALL KEY PIN ON PLUG ENGAGES SLOT IN CYLINDER (FIG. C10).

AN ESTERLINE ANGUS "CHART INSPECTOR" IS RECOMMENDED FOR USE WHEN EXAMINING COMPLETED RECORDS. THIS ACCESSORY IS A CONVENIENT TOOL FOR INSPECTING THE RECORD, MAKING NOTES ON THE PAPER, AND REROLLING CHARTS FOR STORAGE.

ALWAYS KEEP ENOUGH EA CHARTS ON HAND TO OPERATE THE RECORDER FOR AT LEAST ONE MONTH. BY PURCHASING IN LARGE QUANTITIES WORTHWHILE SAVINGS CAN BE REALIZED. STRIP CHARTS MUST BE ORDERED BY ASSIGNED NUMBER, WHICH WILL BE FOUND ON THE RIGHTHAND EDGE OF EACH PRINTED CHART.

ESTERLINE ANGUS CHARTS ARE CURRENTLY AVAILABLE IN USEFUL LENGTHS OF 103 FEET (INK TYPES); AND 81 FEET (THERMAL TYPES). THE TOTAL RUNNING TIME FOR ANY CHART WILL, OF COURSE, DEPEND UPON THE CHART SPEED EMPLOYED. CHART RUNNING TIMES, FOR VARIOUS CHART SPEEDS, ARE SHOWN IN THE FOLLOWING TABLE. SERIES "S" DRIVES CAPABLE OF PRODUCING THESE RECORDING PERIODS ARE ALSO LISTED.

RECORDING TIMETABLE

CHART CHARACTERISTICS				APPLICABLE CHART DRIVES (STYLE NUMBER)											
STANDARD CHART SPEED	TRAVEL TIME PER INCH	MINIMUM CONTINUOUS RUNNING TIME*		200	203	206	209	212	215	218	221	224	227	232	234
		INK CHARTS	THERMAL CHARTS												
3/4 IN/HR.	80 MIN.	65-2/3 DAYS	51 DAYS	x	x					x	x	x	x		x
1-1/2 IN/HR.	40 MIN.	32-1/3 DAYS	25-1/2 DAYS	x	x					x	x	x	x		x
3 IN/HR.	20 MIN.	15-2/3 DAYS	12-3/4 DAYS	x	x					x	x	x	x		x
6 IN/HR.	10 MIN.	7-1/3 DAYS	6-3/8 DAYS	x	x					x	x	x	x		x
12 IN/HR.	5 MIN.	3-2/3 DAYS	3-3/16 DAYS	x	x					x	x	x	x		x
3/4 IN/MIN.	80 SEC.	26-2/3 HOURS	20-4/5 HOURS			x	x			x	x	x	x	x	
1-1/2 IN/MIN.	40 SEC.	13-1/3 HOURS	10-2/5 HOURS			x	x			x	x	x	x	x	
3 IN/MIN.	20 SEC.	6-2/3 HOURS	5-1/5 HOURS			x	x			x	x	x	x	x	
6 IN/MIN.	10 SEC.	3-1/3 HOURS	2-3/5 HOURS			x	x			x	x	x	x	x	
12 IN/MIN.	5 SEC.	1-2/3 HOURS	1-3/10 HOURS			x	x			x	x	x	x	x	
3/4 IN/SEC.	1.33 SEC.	26-2/3 MINUTES	20-3/4 MINUTES					x	x			x	x	x	x
1-1/2 IN/SEC.	667 MS	13-1/3 MINUTES	10-3/8 MINUTES					x	x			x	x	x	x
3 IN/SEC.	333 MS	6-2/3 MINUTES	5-3/16 MINUTES					x	x			x	x	x	x
6 IN/SEC.	167 MS	3-1/3 MINUTES	2-5/8 MINUTES					x	x			x	x	x	x

* ALL CALCULATIONS TAKE INTO CONSIDERATION 3 FEET OF CHART FOR INSTALLATION. CHARTS FOR HOUR SPEEDS ALSO ALLOW FOR THE LOSS OF AN ENTIRE 24-HOUR PERIOD, SO THAT THEY MAY ALWAYS BE SET TO THE TIME OF DAY.

ADJUSTMENTS

Although all Esterline Angus Recorders are carefully adjusted for standard operation before leaving the factory, certain field adjustments are made possible to satisfy special applications and as a preventive maintenance measure.

Chart Guides -- The paper guides located on top of the drive roller are properly adjusted at the factory and will not normally require attention in the field. If the drive has been subjected to rough handling or has been disassembled in the field, readjustment of the guides may be necessary. The correct position of the chart guides is evident when there is no tendency of the paper to be depressed into the grooves of the drive roller.

The turned-down edge "A", Fig. C9, should follow the contour of the drive roller, but allow enough clearance so that there is no drag on the paper. It may be necessary to loosen screws "B" (2 per guide), in order to facilitate this adjustment.

Drive Roller -- The drive roller retainer, Fig. C9, exerts an exact amount of bearing pressure to limit roller end-shake; thus fixing the position of the roller and eliminating lateral motion of the chart paper.

End-shake is varied by loosening or tightening screw "X" (Fig. C9). A correct setting is obtained when the small gap between the brass bearing and the plastic end piece of the roller (point "P") remains constant as the roller drum is whirled by hand. If this screw is too loose the roller will drift back and forth; and, if too tight, the roller will not spin freely. Although this adjustment has been correctly set at the factory, readjustment may be necessary if screw "X" has been inadvertently moved.

Reroll Clutch -- For optimum chart drive operation, the reroll system must apply a regulated amount of tension on the chart paper at all times. To supply this tension, the reroll cylinder contains a small clutch as part of its removable gear assembly. Clutch tension is adjusted by withdrawing this assembly from the reroll cylinder and turning the adjustment nut as required. See Fig. C10.

If clutch tension is too great, the chart paper may start to wrinkle as it leaves the drive roller. In extreme cases, the paper may even tear or skip pins on the drive roller. If there is not enough tension, the chart paper may tend to sag and not wrap properly on the reroll cylinder. These conditions will not exist when the clutch is correctly adjusted.

NOTE: Do not attempt to adjust the clutch unless reroll trouble has been traced to this possible source.

Drive Chain -- The chain and sprocket mechanism on the right side of the instrument chassis must be correctly installed for reliable operation of the chart transport. Recommended orientation and tension of the chain are shown in Fig. C11. Note direction of chain links and the slight amount of chain sag under load. Chain tension may be adjusted by loosening the mounting screws of the transmission components and moving them backward or forward as required. This adjustment will normally entail considerable disassembly and should not be performed unless absolutely necessary.

NOTE: Do not lubricate the chart drive chain.

DISASSEMBLY

To remove the chart transport assembly from the instrument, lower the transport assembly to the chart-loading position. Carefully lift straight up on the transport and remove from front of recorder. To reassemble, reverse the above procedures being careful to mesh the gears properly without force. Further disassembly of the chart drive is not recommended for field maintenance.

> WARNING: Recorders connected to electrical circuits may be hazardous. To prevent accidental shock, always remove power from the instrument before disassembling or servicing.

CLEANING AND LUBRICATION

The entire chart drive mechanism should be cleaned at regular intervals depending upon environmental conditions. A soft-bristled brush, vacuum, or low-pressure air gun may be used to dis-lodge foreign particles and dirt from the chart drive mechanism. If ink or other liquids are accidentally spilled on the chart transport assembly, clean the unit immediately using a soft cloth or paper towel moistened with water.

All bearings of the chart drive system are self-lubricating and will not require relubrication under normal operating and environmental conditions. If bearing lubrication is deemed necessary, use EA 40 oil. This oil is available from Esterline Angus Instrument Company in one-ounce bottles, and it is for use on chart drives normally operated at temperatures of 20° to 100°F. Operating temperatures outside of this range will require special lubrication (consult factory). Do not oil ratchets and pawls; they operate better when dry. When oiling exposed bearing surfaces it is well to remember that too much lubrication is almost as bad as too little.

When synchronous Bodine motors are employed, they will require lubrication once each year. Using EA 40 oil, add 50 drops to the red hole, and 20 drops to the yellow hole at the drive-shaft end of the motor. Also add 4 drops in the red hole at the opposite end of the motor. Synchronous EA motors used for hour speeds ONLY are lubricated for life. Do not attempt to relubricate. After 5 to 10 years of service, a chart drive should be returned to the factory for complete inspection, cleaning, and overhauling.

REPLACEMENT PARTS

All parts for Series "S" chart drives are made available directly from Esterline Angus Instrument Company. When ordering parts, always give part numbers and instrument serial number. Refer to the assembly drawing in this manual for parts indentification.

CHART DRIVE SPECIFICATIONS

SYNCHRONOUS MOTOR

Time Base.....Power Line Frequency
Voltage Source.....120 or 240* V AC (±10%)
Source Frequency.....50 or 60 cps
Power Consumption.....20 to 60 Volt-Amps
Protection Feature.....Rear-Panel Fuse

* May require external transformer.

TRANSMISSION (optional)

Single Speed.....Hr., Min.,or Sec.
Multi-Speeds..(Hr,Min,or Sec) (Hr-Min) or (Hr-Min-Sec.)
External Drive Provision....Ball and Cross-pin Coupling

CHART TRANSPORT

"ON" Indicator.....Front-Panel Lamp
Pin Roller.....Dual-ended Drive
Chart Supply Gage.....Front Panel Indicator
Chart Take-Up.....Automatically Regulated Reroll
Writing Table.....5" Length with Tear Bar
Standard Speeds:
  Inches/Unit Time.....0.75, 1.5, 3.0, 6.0, 12
  MM/Unit Time.....19.05, 38.1, 76.2, 152.4, 304.8

PANEL CONTROLS (optional)

Power (On-Off).....2-Pos. Switch
Electric Speed Control.....3- or 4-Pos. Switch
Feed-rate Selector.....5-Pos. Mechanical Type
Manual Time-Set.....Drive Roller Knob

CHART CHARACTERISTICS

Ink Paper.....6" X 103' (15mm X 31m)
Thermal Paper.....6" X 81' (15mm X 25m)
Printed Coordinates.....4.5" Span (Rectilinear)

SERVICE FEATURES

Chart Loading.....Tilt-Down Transport
Paper Tension.....Adjustable Reroll Clutch
Lift-off Transport.....Direct Gear-Mesh Coupling

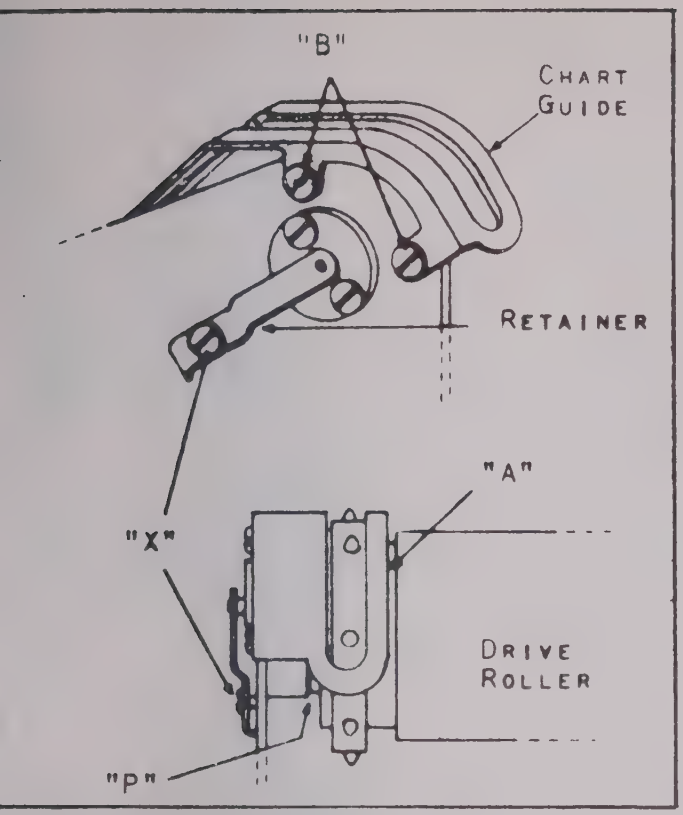


FIG. C9. CHART GUIDE AND RETAINER ADJUSTMENTS.

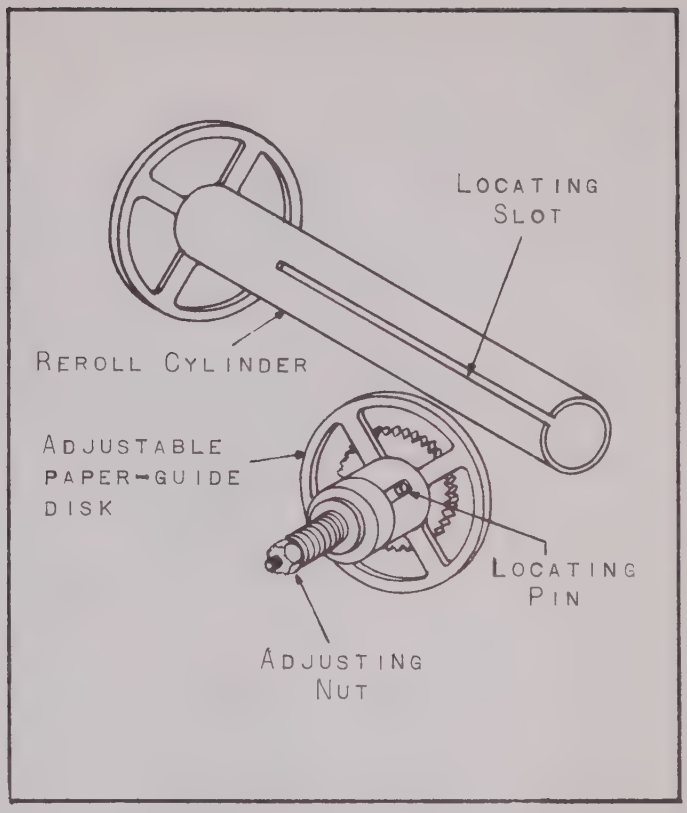


FIG. C10. REROLL CLUTCH ADJUSTMENT.

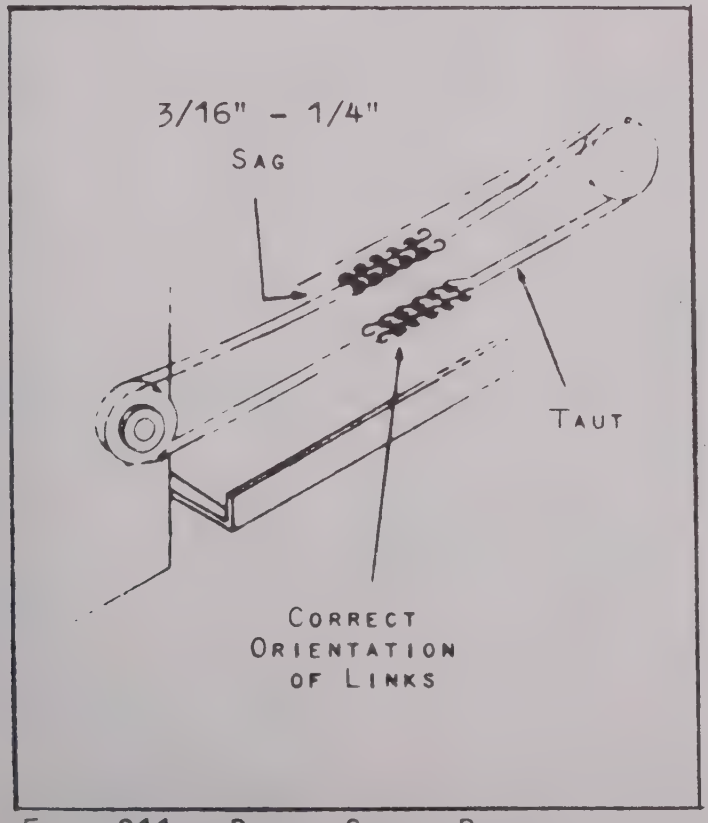
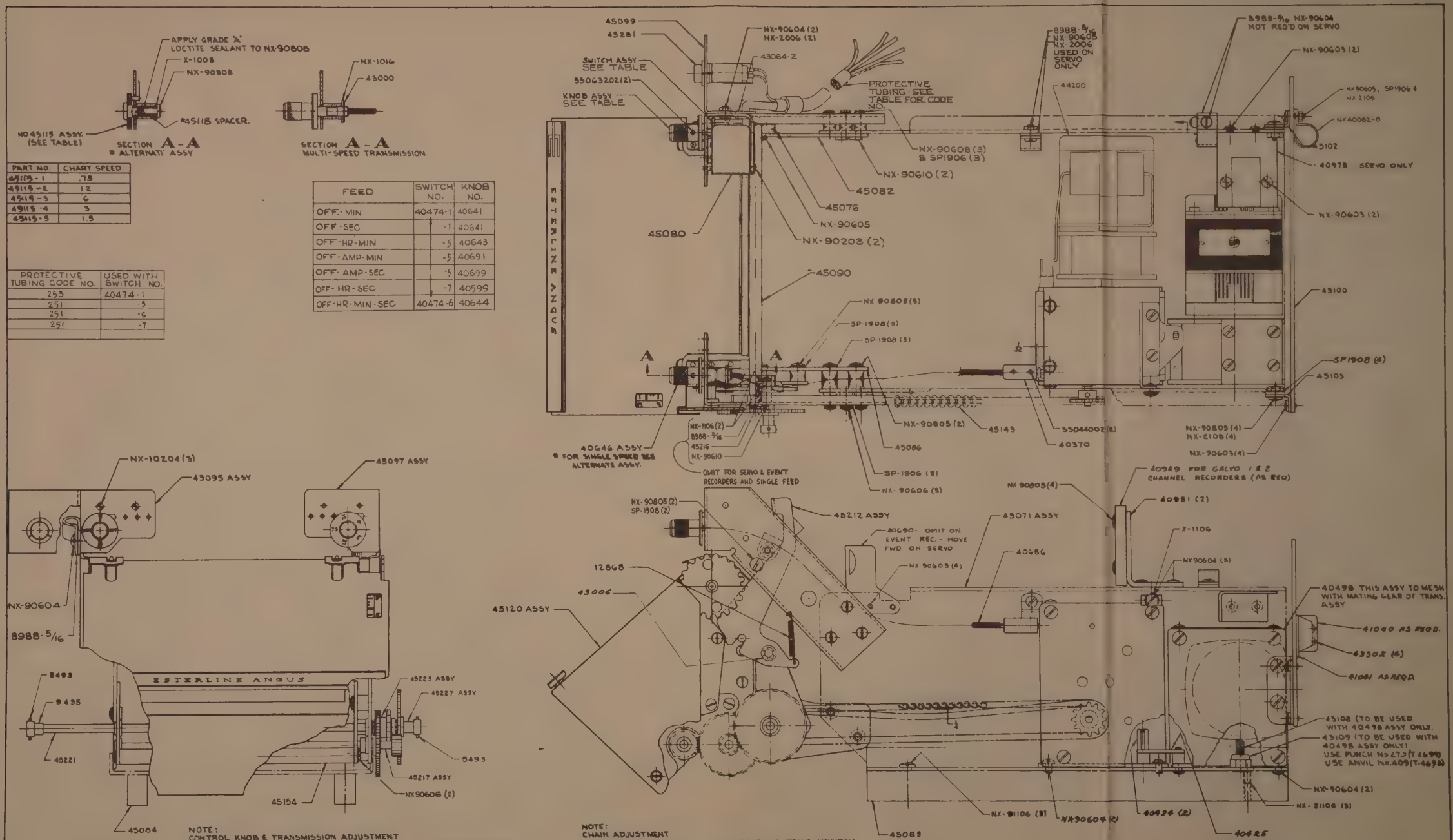


FIG. C11. DRIVE CHAIN POSITIONING.



PART NO.	CHART SPEED
45115-1	.75
45115-2	12
45115-3	6
45115-4	3
45115-5	1.5

PROTECTIVE TUBING CODE NO.	USED WITH SWITCH NO.
253	40474-1
251	-5
251	-6
251	-7

FEED	SWITCH NO.	KNOB NO.
OFF-MIN	40474-1	40641
OFF-SEC	-1	40641
OFF-HR-MIN	-5	40643
OFF-AMP-MIN	-5	40691
OFF-AMP-SEC	-5	40699
OFF-HR-SEC	-7	40599
OFF-HR-MIN-SEC	40474-6	40644

NOTE:
CONTROL KNOB & TRANSMISSION ADJUSTMENT
1. PLACE CONTROL KNOB (40646) ON CONTROL SHAFT (40686) ALIGNING SET SCREW WITH FLAT ON SHAFT
2. ADJUST KNOB LATERALLY ON SHAFT, SO KNOB & SHAFT ROTATE FREELY & DETENT PIN MAKES FIRM CONTACT WITH DETENTS IN BACK OF KNOB FLANGE TIGHTEN SET SCREW
3. WITH TRANS. CAM & CONTROL KNOB SET ON 1.5 SPEED, PLACE COUPLING (40370) ON TRANS. CONTROL SHAFT & PLACE CABLE END IN "D" HOLE OF COUPLING
4. POSITION COUPLING WITHIN APPROX. 1/32 OF TRANS. (AS SHOWN) & TIGHTEN SET SCREWS
5. PAINT SET SCREW ON TRANSMISSION END OF COUPLING WITH RED LACQUER

NOTE:
CHAIN ADJUSTMENT
1. TAKE UP ALL SLACK IN CHAIN BY LOOSENING TRANS. MOUNTING SCREWS (6) & MOVING TRANSMISSION TO REAR
2. SNUG UP TRANS. MOUNTING SCREWS, BUT DO NOT TIGHTEN
3. SET SLACK IN CHAIN BY TAPPING TRANS. FORWARD TO OBTAIN APPROX. 1/4 SLACK (AS SHOWN)
4. TIGHTEN TRANS. MOUNTING SCREWS

LABGRAPH
CHART DRIVE ASSEMBLY
(HR - MIN - SEC FEEDS WITH EXTERNAL COUPLING)

ESTERLINE ANGUS INSTRUMENT CO., INC.
INDIANAPOLIS, INDIANA, U.S.A.

EVENT RECORDER SPECIFICATIONS

MODELS S620X AND S620T

These E-A instruments are designed to record event information from as many as twenty different sources simultaneously, and on a single chart 6" in width. The writing elements record time and duration of events on separate channels. Each element is actuated by a small electromagnet, which in turn is connected to the circuit or system being monitored. When the electromagnet is energized, the element is displaced approximately 1/10" from a reference line on the chart. When the electromagnet is de-energized, the element automatically returns to its reference.

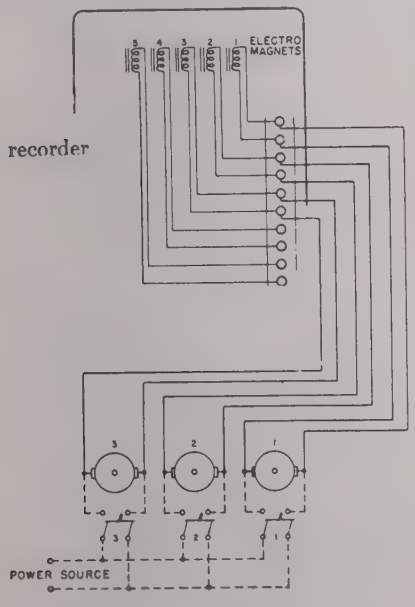
The electromagnet coils are operated by either AC or DC voltages in a number of circuit configurations—depending upon the particular type ordered. Standard configurations are shown below. Each electromagnet assembly consists of a coil winding, an iron core, and a lever-type armature. The coils are wired to terminal connectors on the rear of the instrument.

Inkless event recorders with "Tempen" have an internal stylus-heating circuit especially designed to produce graphic records without smoke, fumes, or odor. All styluses are connected in series and are heated by a direct-current source.

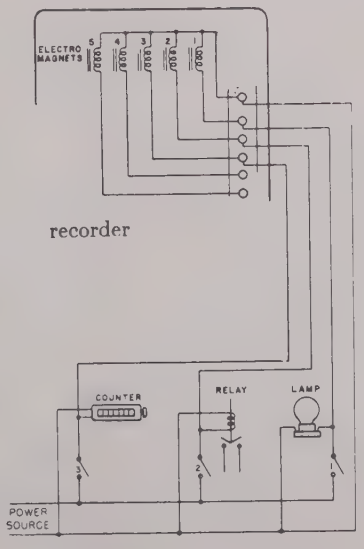
ELECTRICAL RATINGS

Electromagnet Voltage Rating	Coil Style	Current (MA)	DC Resistance (ohms)	Power Consumption (Watts)
Direct Current				
2V	N	570	3.5	1.1
4V	K	286	14	1.1
6V	J	231	26	1.4
8V	G	131	61	1.0
10V	F	99	101	1.0
12V	F	119	101	1.4
14V	E	90	156	1.3
16V	D	67	238	1.1
18V	D	76	238	1.4
24V	C	65	372	1.6
28V	B	42	666	1.2
32V	A	29	1092	0.9
48V	T	29	1650	1.4
125V	T	31	1650 ①	3.9
250V	T	26	1650 ②	6.5
50-60 cps AC				
6V	N	447	3.5	1.6
12V	K	233	14	1.7
24V	G	103	61	1.5
120V ④	G	103	61	1.5
120V	T	20	1650	1.5
240V ④	G	103	61	1.5
240V	T	21	1650 ③	4.5

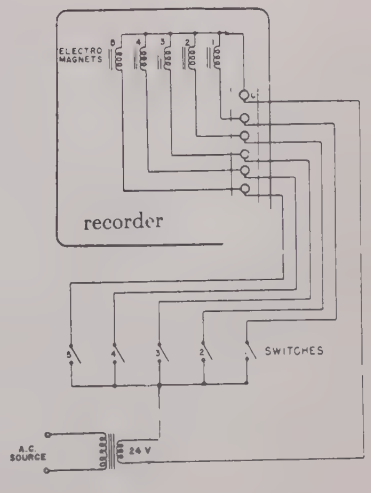
① Requires 3000-ohm series resistance. ③ Requires 7000-ohm series resistance.
② Requires 8000-ohm series resistance. ④ Used with external step-down transformer for 24V switch-type operation.



—Wiring diagram of voltage type, separate return recorder. Separate return circuits are available only on voltage type recorders



—Wiring diagram of voltage type, common return recorder actuated by line voltage across signal lamps, relays or counters.



—Wiring diagram of switch type recorder. This instrument is furnished only with common return circuits

620 .5M664

GENERAL SPECIFICATIONS

* INSTRUMENT TYPE

EVENT.....RECTILINEAR
ACTUATION.....ELECTROMAGNETS

* RECORD CHARACTERISTICS

CHANNEL SPACING (APPROX.)..1/4"
ELEMENT DISPLACEMENT.....1/10"

* OPERATING LIMITS

RATED OPERATING VOLTAGE....±15%
AMBIENT TEMP.....+20 TO +120°F

* RESPONSE

REPETITION (MAX.)..10 PULSES/SEC.
PULSE WIDTH (MIN.).....15 MS.

* DIELECTRIC RATING
(ONE MINUTE TEST)

TERMINALS TO CHASSIS....1,500V AC

* STEP-DOWN TRANSFORMER
(FOR SWITCH-TYPE ONLY)

PRI.....120 OR 240V (50-60 CPS)
SEC.....24V (50-60 CPS)

INK MODEL S620X

RECORDING MEDIA.....PAPER STRIP-CHART, 6" X 103'
METHOD OF WRITING.....PEN AND INK
INK SUPPLY.....WELL CAPACITY 1-1/4 OZ.
EVENT PEN INDICATOR.....CHANNEL-NUMBERED SCALEPLATE
OPTIONAL FEATURES.....5, 10, 15, OR 20 ACTIVE CHANNELS; CONNECTIONS (ISOLATED, COMMON, OR SWITCH); TOTALING COUNTERS.

INKLESS MODEL S620T

RECORDING MEDIA.....HEAT-AND PRESSURE-SENSITIVE STRIP CHART, 6" X 81"
METHOD OF WRITING.....ELECTRICALLY-HEATED STYLUSES
STYLUS INDICATOR.....CHANNEL-NUMBERED SCALEPLATE
ADJUSTMENTS.....ON-OFF HEAT SWITCH, HEAT CONTROL, STYLUS PRESSURE ADJUST.
POWER REQUIREMENTS (STYLUS HEAT).....40 VA AT 120 OR 240V AC, ±10%, 50-60 CPS.
OPTIONAL FEATURES.....10 OR 20 ACTIVE CHANNELS; CONNECTIONS (ISOLATED, COMMON, OR SWITCH); TOTALING COUNTERS; 12V-DC HEATING CIRCUIT.

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ESTERLINE ANGUS INSTRUMENT COMPANY, INC.

P.O. BOX 24000, INDIANAPOLIS, INDIANA 46224

(SHIPPING ADDRESS: 1201 MAIN ST., SPEEDWAY, IND.)

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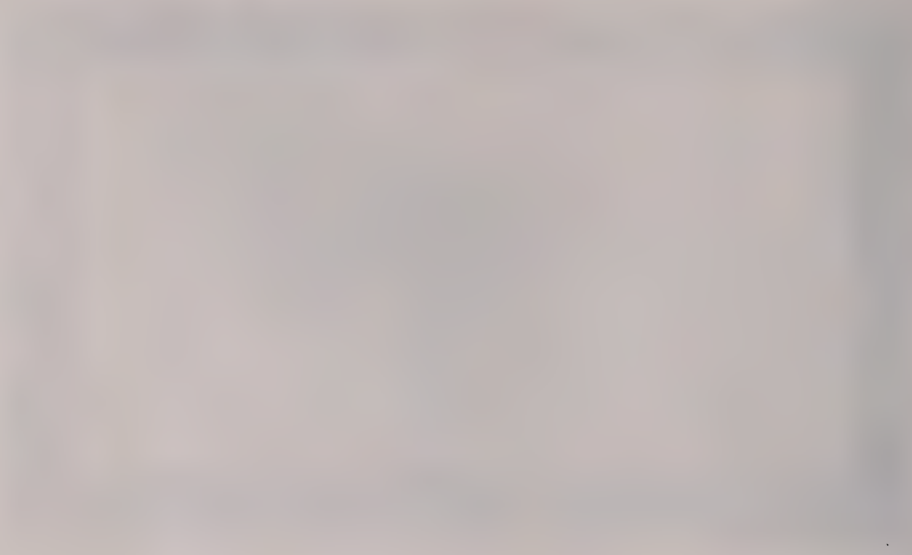

ESTERLINE ANGUS

Division of Esterline Corporation, Box 24000, Indianapolis, Ind., 46224 U.S.A.

If you have further questions about our products, or want to know more about an instrument application or require service, please call or write the nearest office — the phone number and address is given below.

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WITH REMOTE CONTROL

40474-6 SWITCH

BLACK - TERM 2 - TO TB-1

HOUR KEY
MINUTE YELLOW
SECOND BLUE
PILOT LIGHT VIOLET

LOCAL — REMOTE

RED TERM 3
YELLOW TERM 4
BLUE TERM 5
VIOLET TERM 6

4 PDT SW. EACH #45271 CH. 7664 K5 (OR EQUIV.)

41040-17 (3) TO TB-1

RED TERM 3
YELLOW TERM 4
BLUE TERM 5
VIOLET TERM 6

TO TB-2

45173

43124 (2) NO. 10 SHRINKABLE TUBING EA STK #0704 3/4 LG. (2) ND40060-43 TUBING 3/4 LG. (1)

GRAY TERM. 1 ▷ TO TB-1

45181 PILOT LIGHT

GRAY TERM. 6 — TO TB-1 WITHOUT REMOTE CONTROL

RED TERM. 5 — TO TB-2 WITH REMOTE CONTROL

TYP. CONN. FOR MORE THAN 2 WIRES

2ND. SPEED MOTOR

BLUE TERM 1 > TO TB-1

40497

WITHOUT REMOTE CONTROL

BLACK TERM. 2
VIOLET TERM. 3
RED TERM. 5 > TO TB-1
YELLOW TERM. 4
BLUE TERM. 6

40474-6

BLACK TERM. 3 — TO TB-1 WITHOUT REMOTE CONT.

RED TERM. 4 — TO TB-2 WITH REMOTE CONT.

WHITE TERM. 1 ▷ TO TB-1

40475-2 HR.-MIN. MOTOR

BLACK TERM 2

TB-2
TERM. 41040-6
MARKER 41041-9

43020 (2) 1 1/4 LG NO.4 TUBING EA STK NO. 0248

STYLUS ASSY 40170-10

RED

BLACK

TRANS. PLATE ASSY. 45168

WHITE TERM. 1 ▷
BLACK TERM. 7
RED TERM. 8

BROWN
BROWN

WHITE/BROWN

YELLOW

WHITE/RED TERM 9

BROWN

TO TB-1

(D) ‡ 17495 SHOWN; OR 17467

20222-40

TB-1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

CHANNEL 1 BLACK
CHANNEL 2 BLACK
ORANGE
CHANNEL 3 BLACK
YELLOW
GREEN
CHANNEL 4 BLACK
BLUE
CHANNEL 5 BLACK
VIOLET
CHANNEL 7 BLACK
GRAY
CHANNEL 8 BLACK
CHANNEL 9 BLACK
TAN
CHANNEL 10 BLACK
WHITE/BROWN
CHANNEL 11 BLACK
WHITE/RED
CHANNEL 12 BLACK

WHITE TO COPPER TERMINAL
BLACK

HR.
MIN.
SEC.
PILOT LIGHT

45125 RECEPTACLE
45029 FUSE HOLDER
14359-2 FUSE

REMOTE CONTROL
(4) SPST SWITCHES
CUTLER & HAMMER 3801 K22
(OR EQUIV.)

WHITE/ORANGE 35
CHANNEL 13 BLACK 36
WHITE/YELLOW 37
CHANNEL 14 BLACK 38
WHITE/GREEN 39
CHANNEL 15 BLACK 40
WHITE/BLUE 41
CHANNEL 16 BLACK 42
WHITE/VIOLET 43
CHANNEL 17 BLACK 44
WHITE/GRAY 45
CHANNEL 18 BLACK 46
CHANNEL 19 BLACK 48
WHITE/BLACK/YELLOW 49
CHANNEL 20 BLACK 50
51

▷ DENOTES SOLDER JOINT WITH TERMINAL NO 43123

SEE TERMINAL ASSY ARRANGEMENT DWG. NO. 45026

FOR EXTERNAL COIL CONNECTION SEE
A. COMMON RETURN 45096
B. SEPARATE RETURN 43094

FOR POLARITY & COMMON RETURN SEE DWG. NO. 45341

ALL LEADS ARE NO. 22 AWG BELDON NO. 8524 UNLESS OTHERWISE SPECIFIED.

ALL PARTS NOS. CALLED OUT ON THIS DRAWING ARE FOR REF. ONLY

• DENOTES SOLDER JOINT. MUST BE MECH. WRAPPED PRIOR TO SOLDERING

ALL POWER SUPPLY WIRES TO TRANSFORMER WILL BE 18 AWG.

✳ DENOTES EXTERNAL CONN. FOR INFORMATION ONLY

(D) ‡ FOR TRANSISTOR & DIODE ASSEM. NO. 17467 USE SCHEMATIC DIAGRAM NO. 17468

LET	CHANGE	DATE
E		
D	ECN 3063	4-10-[illegible]
C	ADDED REM. CONT PRE	10-5-65
B	ECN 483	1-13-65
A	E.C.R. 32	2-1-64

UNLESS OTHERWISE SPECIFIED
1. TOLERANCE ON FRACTIONAL DIM. LENGTH DIAMETER
2. ECCENTRICITY — NOT TO EXCEED .010 INDICATOR READING.
3. PLATED PARTS MUST FIT GAUGES AFTER BEING PLATED.

FINISH

DATE OF PRINT

NOTES

ESTERLINE ANGUS INSTRUMENT CO., INC.
INDIANAPOLIS, IND., U.S.A.

NAME [illegible] WIRING DIAGRAM OF [illegible] 20 PEN STRIP CHART DRIVE HR. MIN. MOTOR

NO. REQ	DWG. NO.	STYLE NO.

CLASSIFICATION

DR. STL. | SCALE

CH.

AP. 10-27-64 | 45[illegible]

MARSAUGH # 10-8133

ACCOPRESS®

25970	YELLOW
25971	BLACK
25972	LIGHT BLUE
25973	DARK BLUE
25974	LIGHT GRAY
25975	LIGHT GREEN
25976	DARK GREEN
25977	TANGERINE
25978	RED
25979	EXECUTIVE RED

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